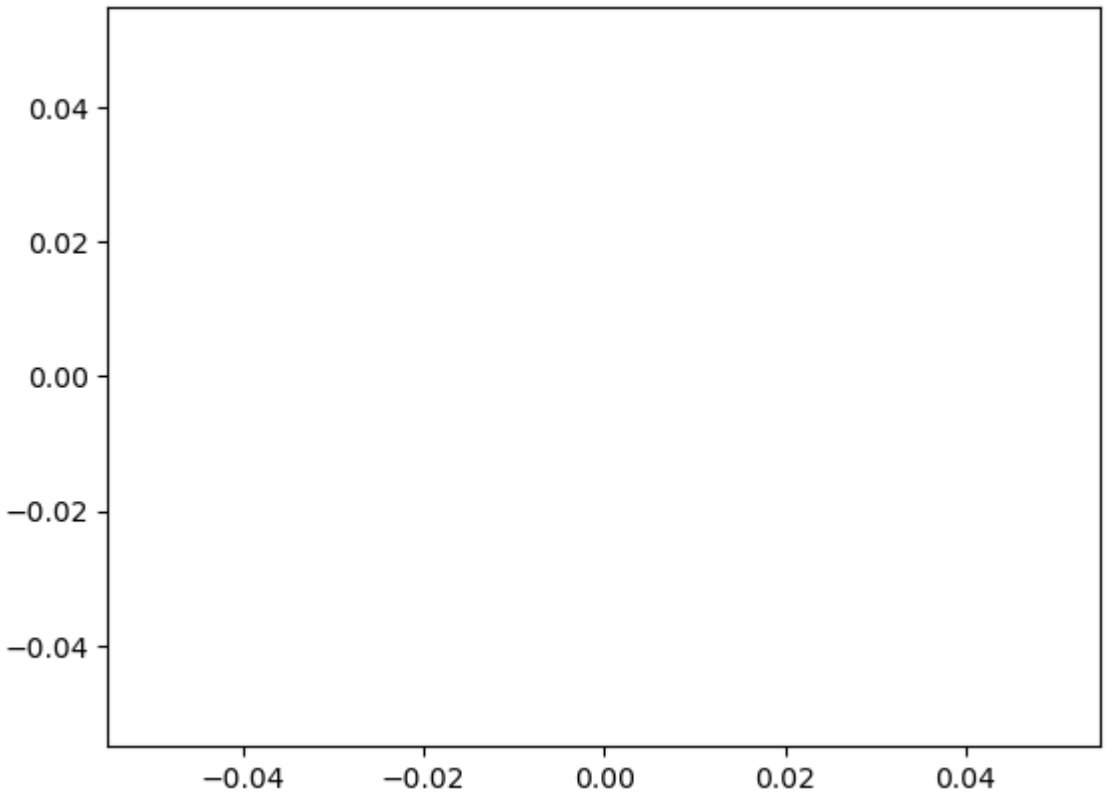
# Introduction to matplotlib

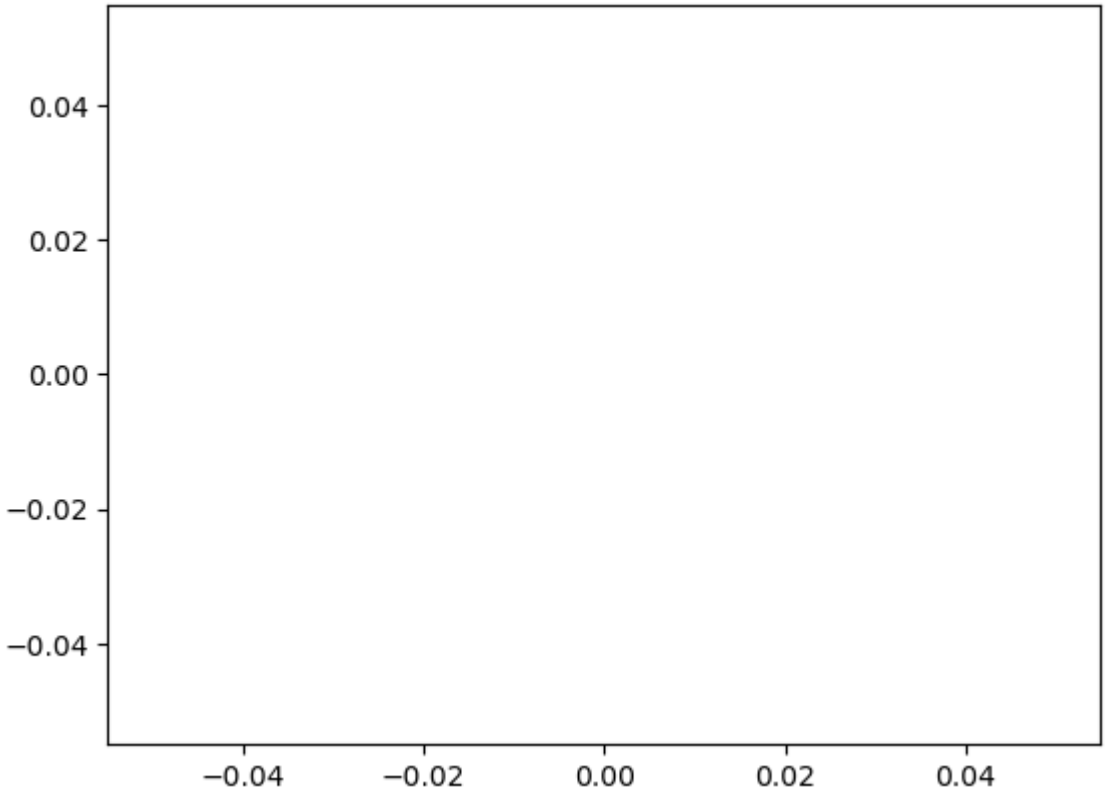
In [1]:
```
%matplotlib inline
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
```

In [2]:
```
# simplest way to create a plot
plt.plot()
```

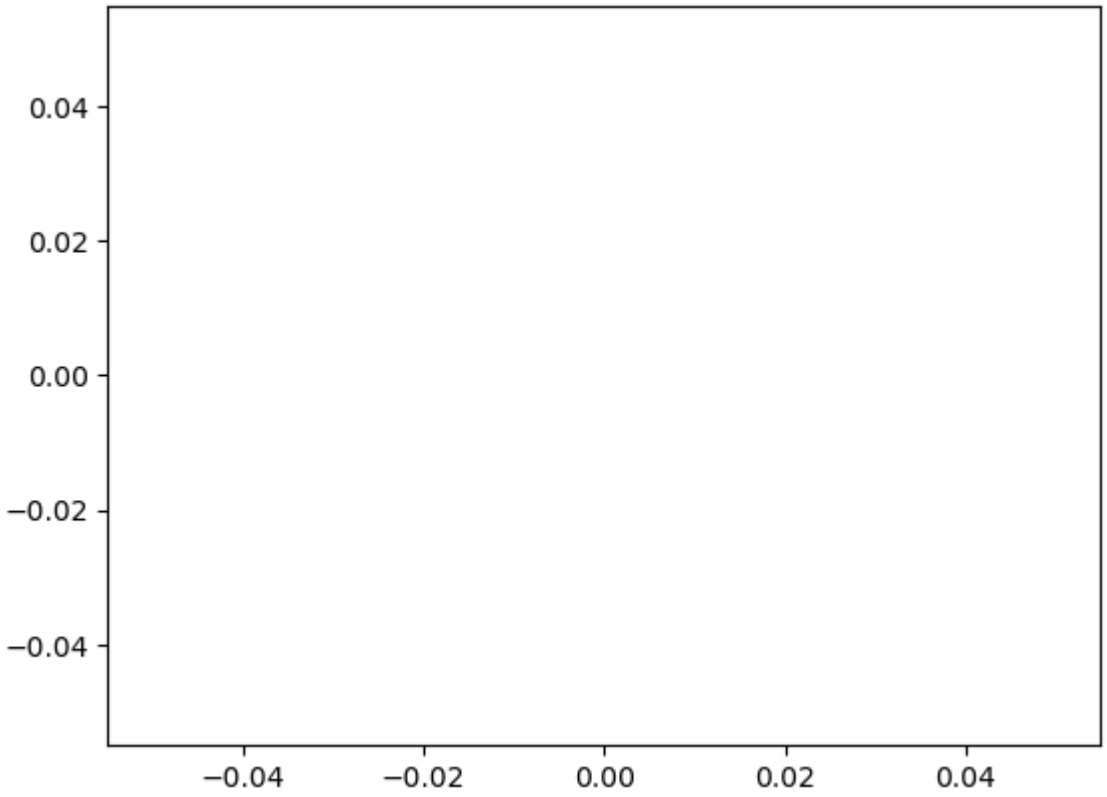
Out[2]:
```
[]
```



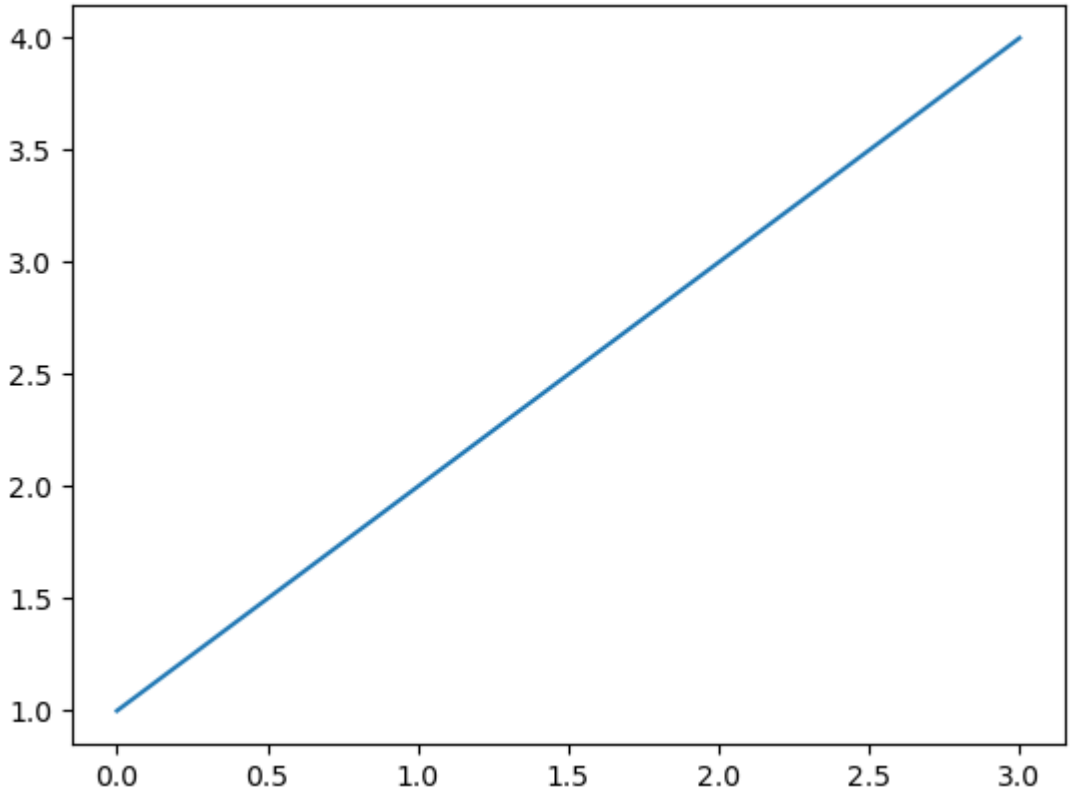

In [3]:
```
# to get rid of the bracket on top of the grpah
plt.plot();
```



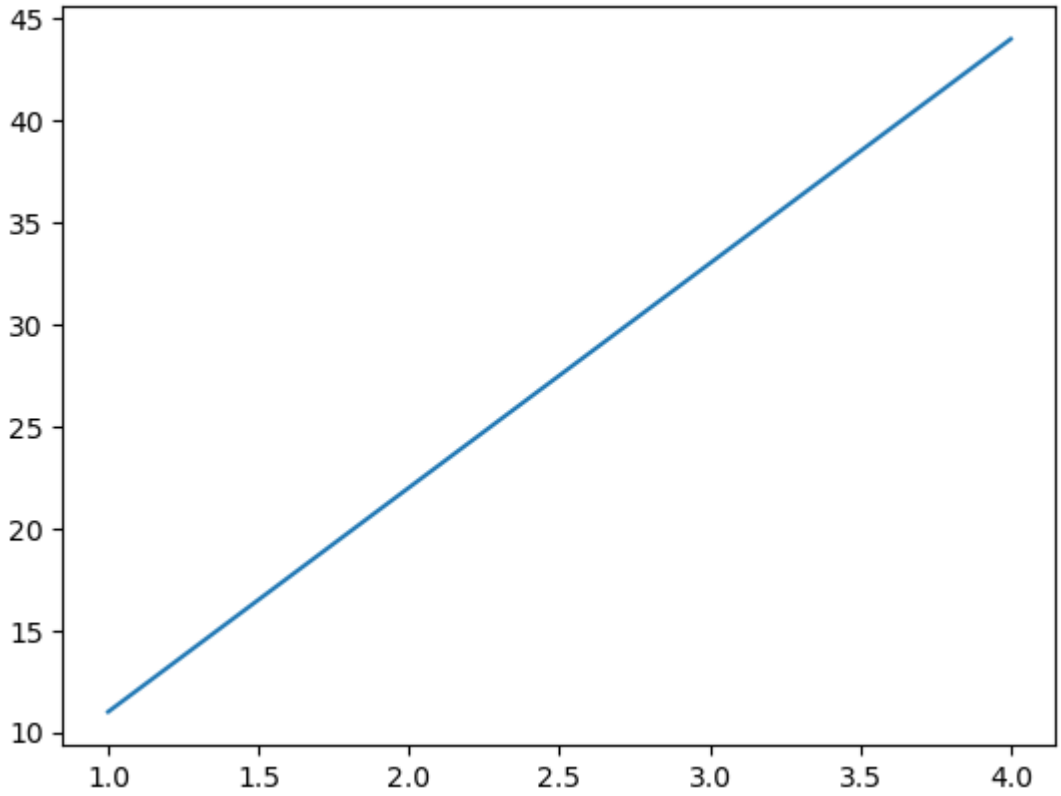

In [4]:
```
plt.plot()
plt.show()
```




In [5]:
```
plt.plot([1, 2, 3, 4]);
```

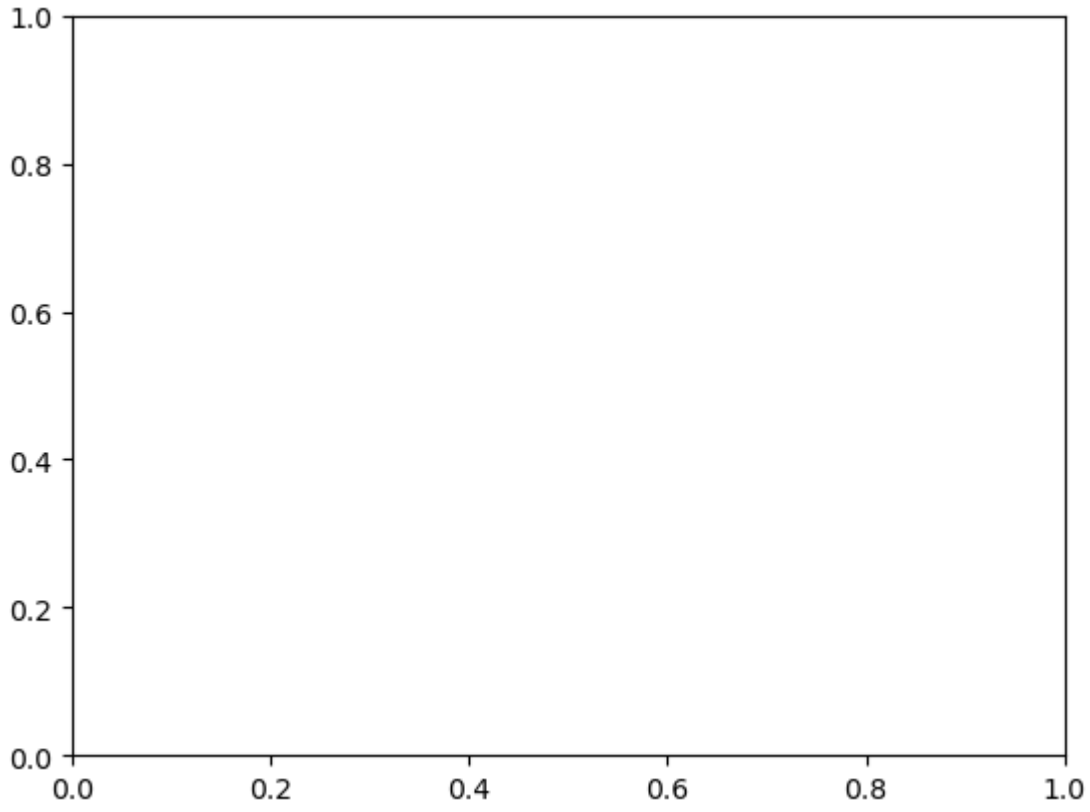



In [6]:
```
x = [1, 2, 3, 4]
y = [11, 22, 33, 44]
plt.plot(x, y);
```

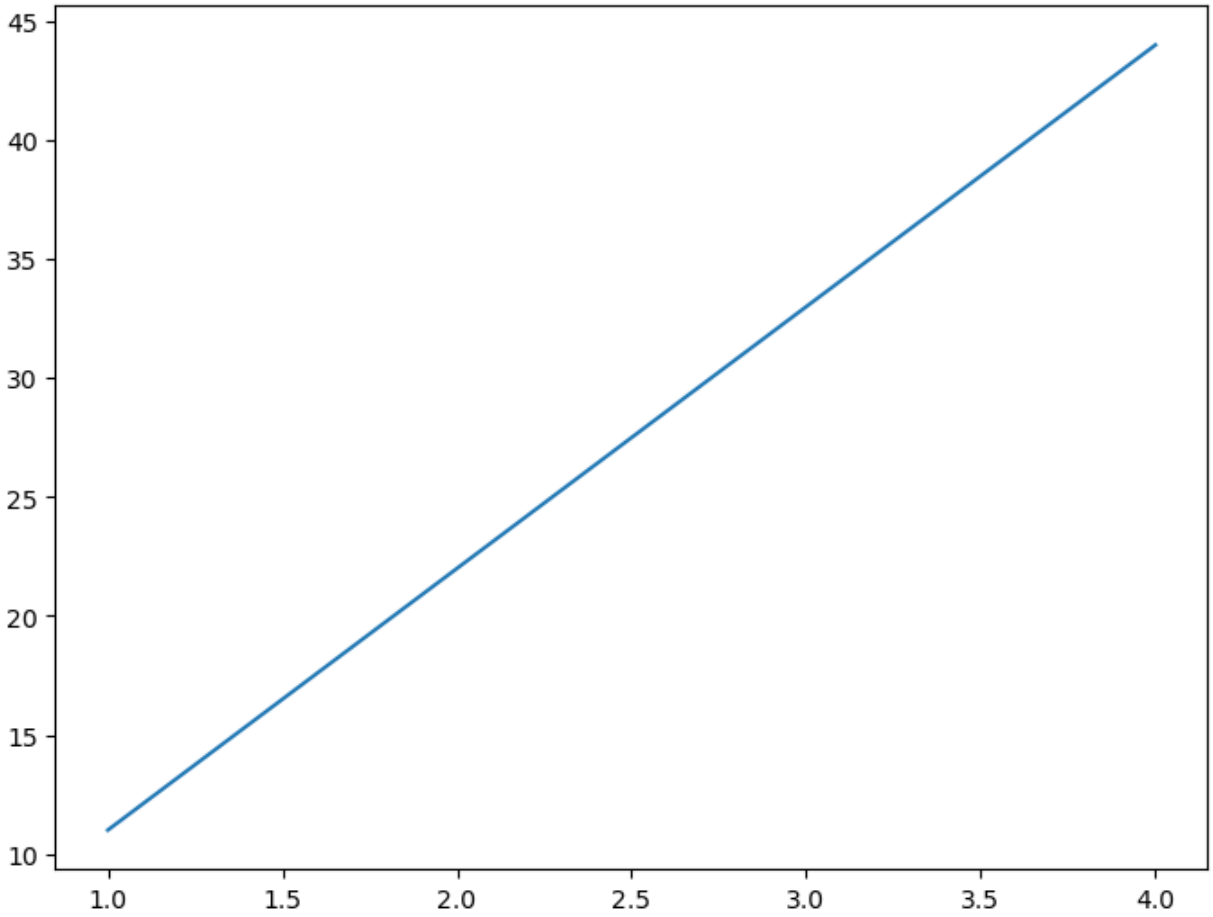



In [7]:
```
# 1st method
fig = plt.figure() # creates a figure
```

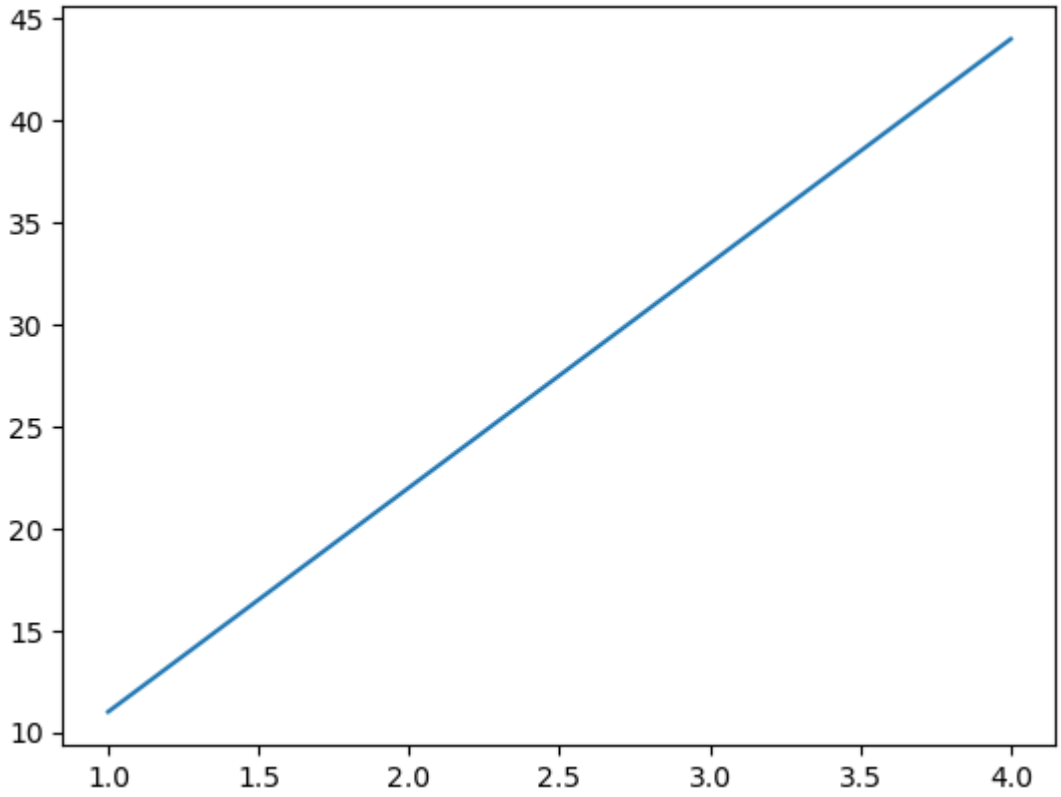
```
ax = fig.add_subplot() # adds some axes
plt.show()
```



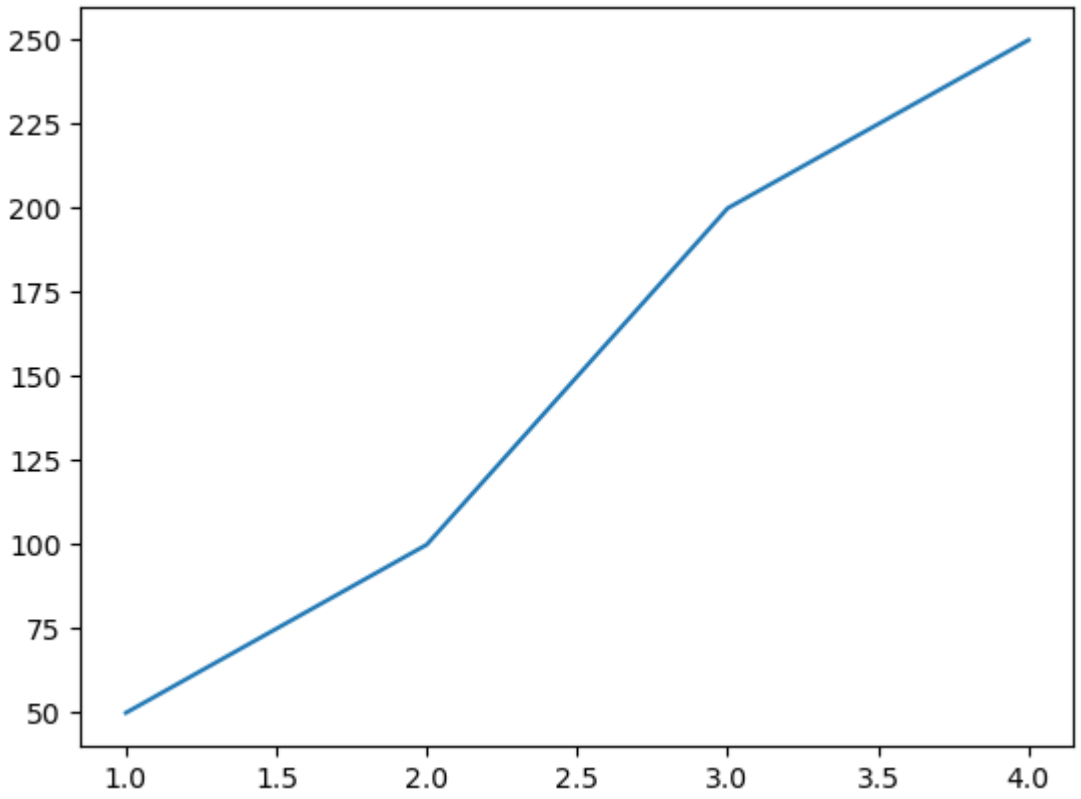

In [8]:
```
# 2nd method
fig = plt.figure() # creates a figure
ax = fig.add_axes([1, 1, 1, 1])
ax.plot(x, y) # add some data
plt.show()
```




In [9]:
```
# 3rd method (recommended)
fig, ax = plt.subplots()
ax.plot(x, y); # add some data
```

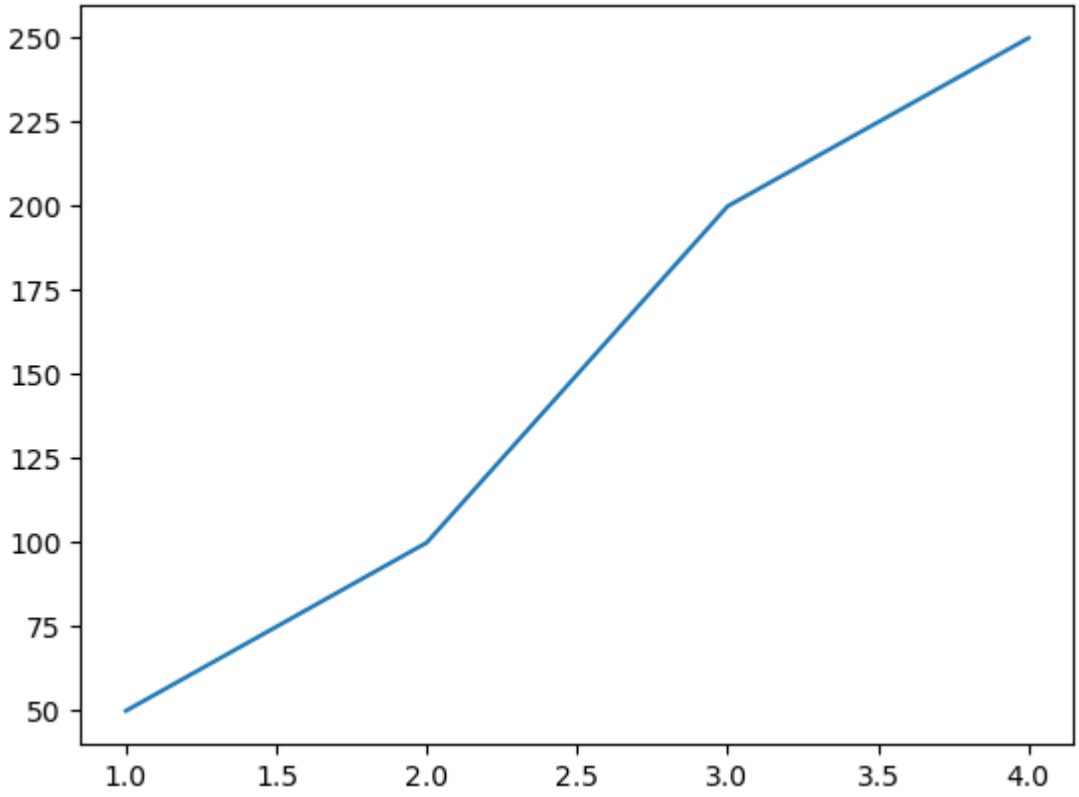


In [10]:
```
# 3rd method (recommended)
fig, ax = plt.subplots()
ax.plot(x, [50, 100, 200, 250]); # add some data
```



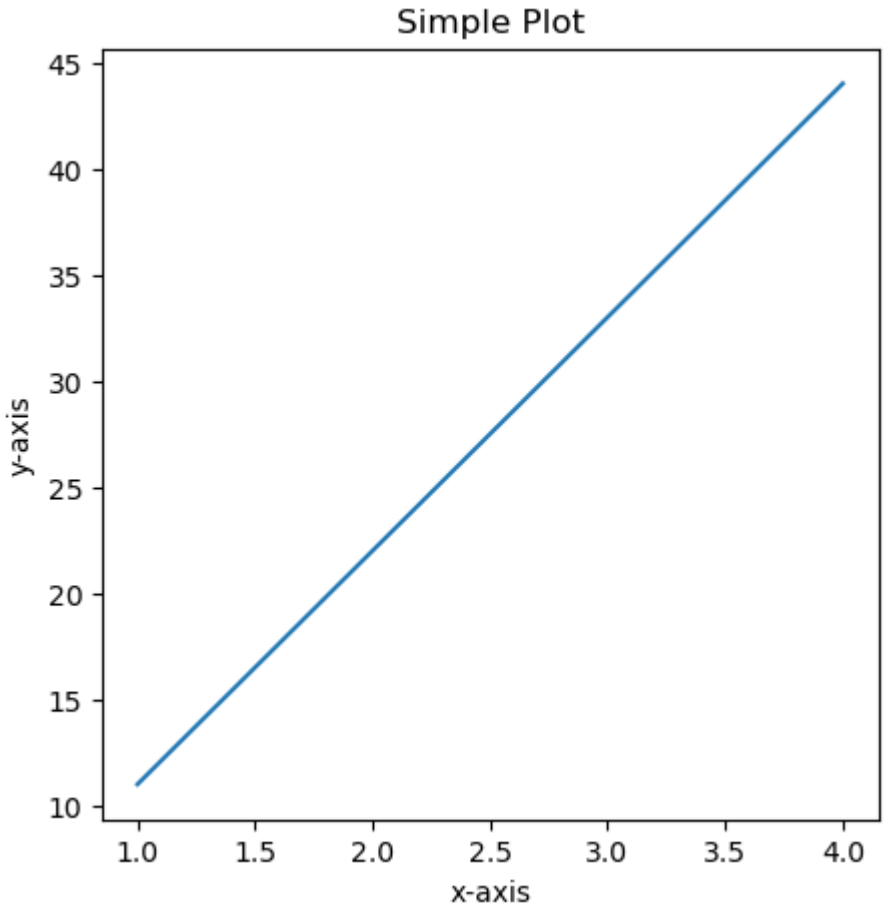

In [11]:
```
fig, ax = plt.subplots()
ax.plot(x, [50, 100, 200, 250]); # add some data
type(fig), type(ax)
```

Out[11]:
```
(matplotlib.figure.Figure, matplotlib.axes._subplots.AxesSubplot)
```




# Matplotlib example workflow

In [12]:
```
#  0. import matplotlib and get it ready for plotting in Jupyter
%matplotlib inline
import matplotlib.pyplot as plt

# 1.  prepare data
x = [1, 2, 3, 4]
y = [11, 22, 33, 44]

# 2. setup plot
fig, ax = plt.subplots(figsize =(5, 5)) #width and height

# 3. plot data
ax.plot(x, y)

# 4. customize plot
ax.set(title='Simple Plot',
      xlabel='x-axis',
      ylabel='y-axis')


# 5. save and show (save the whole figure)
fig.savefig('images/sample_project1.png')
```




# Making figures with Numpy arrays

we want: 1- line plot 2- scatter plot 3- bar plot 4- histogram 5-subplot

In [13]:
```
import numpy as np
```

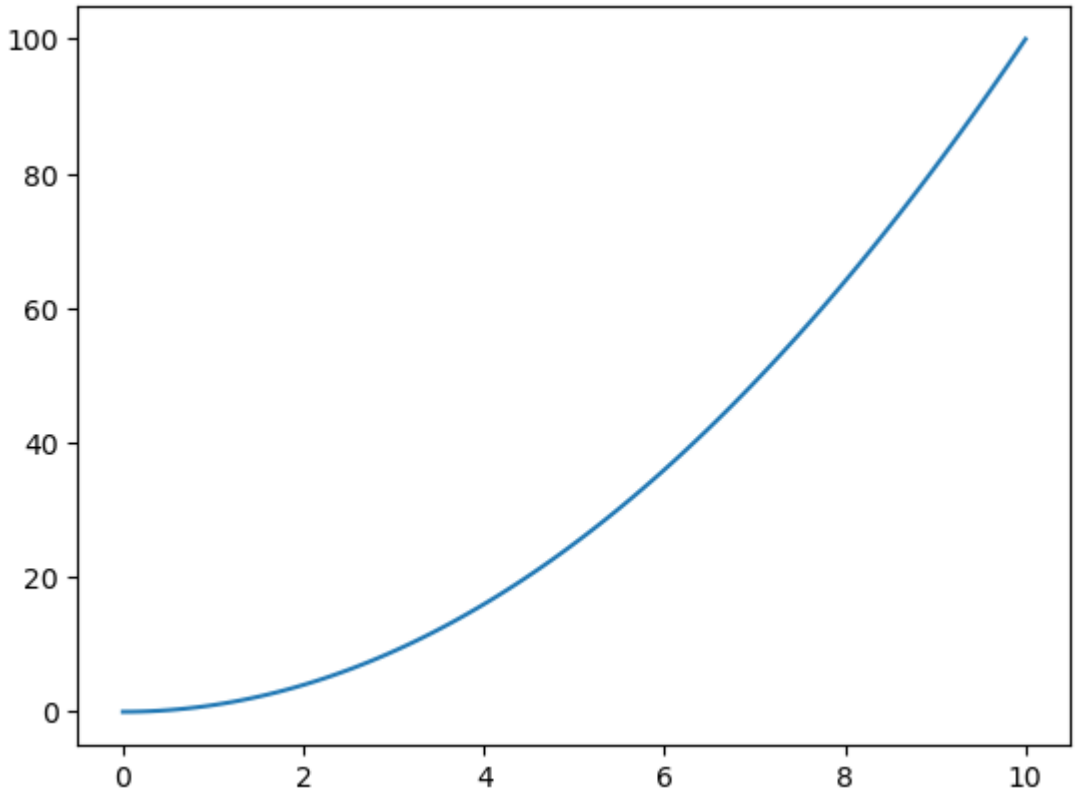
In [14]:
```
# create some data
x = np.linspace(0, 10, 100)
x[: 10] # first 10
```

Out[14]:
```
array([0.        , 0.1010101 , 0.2020202 , 0.3030303 , 0.4040404 ,
       0.50505051, 0.60606061, 0.70707071, 0.80808081, 0.90909091])
```

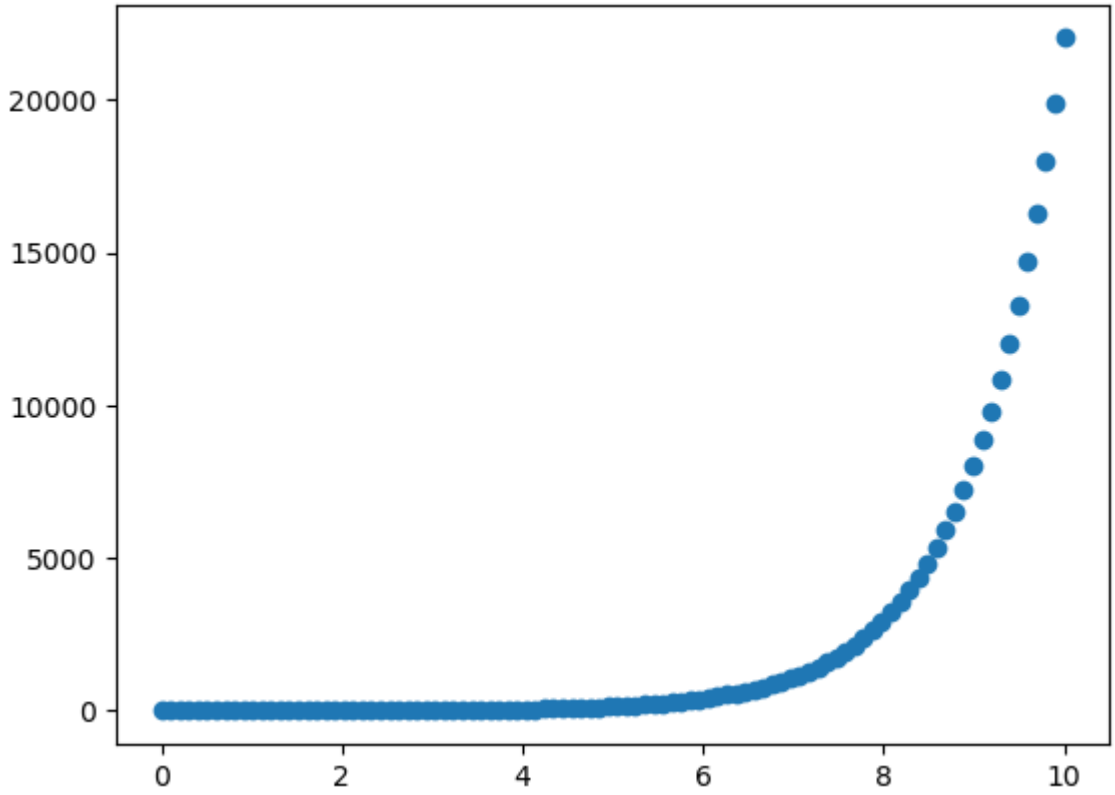
In [15]:
```
x = np.linspace(0, 10, 100)
x
```

Out[15]:
```
array([ 0.        ,  0.1010101 ,  0.2020202 ,  0.3030303 ,  0.4040404 ,
        0.50505051,  0.60606061,  0.70707071,  0.80808081,  0.90909091,
        1.01010101,  1.11111111,  1.21212121,  1.31313131,  1.41414141,
        1.51515152,  1.61616162,  1.71717172,  1.81818182,  1.91919192,
        2.02020202,  2.12121212,  2.22222222,  2.32323232,  2.42424242,
        2.52525253,  2.62626263,  2.72727273,  2.82828283,  2.92929293,
        3.03030303,  3.13131313,  3.23232323,  3.33333333,  3.43434343,
        3.53535354,  3.63636364,  3.73737374,  3.83838384,  3.93939394,
        4.04040404,  4.14141414,  4.24242424,  4.34343434,  4.44444444,
        4.54545455,  4.64646465,  4.74747475,  4.84848485,  4.94949495,
        5.05050505,  5.15151515,  5.25252525,  5.35353535,  5.45454545,
        5.55555556,  5.65656566,  5.75757576,  5.85858586,  5.95959596,
        6.06060606,  6.16161616,  6.26262626,  6.36363636,  6.46464646,
        6.56565657,  6.66666667,  6.76767677,  6.86868687,  6.96969697,
        7.07070707,  7.17171717,  7.27272727,  7.37373737,  7.47474747,
        7.57575758,  7.67676768,  7.77777778,  7.87878788,  7.97979798,
        8.08080808,  8.18181818,  8.28282828,  8.38383838,  8.48484848,
        8.58585859,  8.68686869,  8.78787879,  8.88888889,  8.98989899,
        9.09090909,  9.19191919,  9.29292929,  9.39393939,  9.49494949,
        9.5959596 ,  9.6969697 ,  9.7979798 ,  9.8989899 , 10.        ])
```

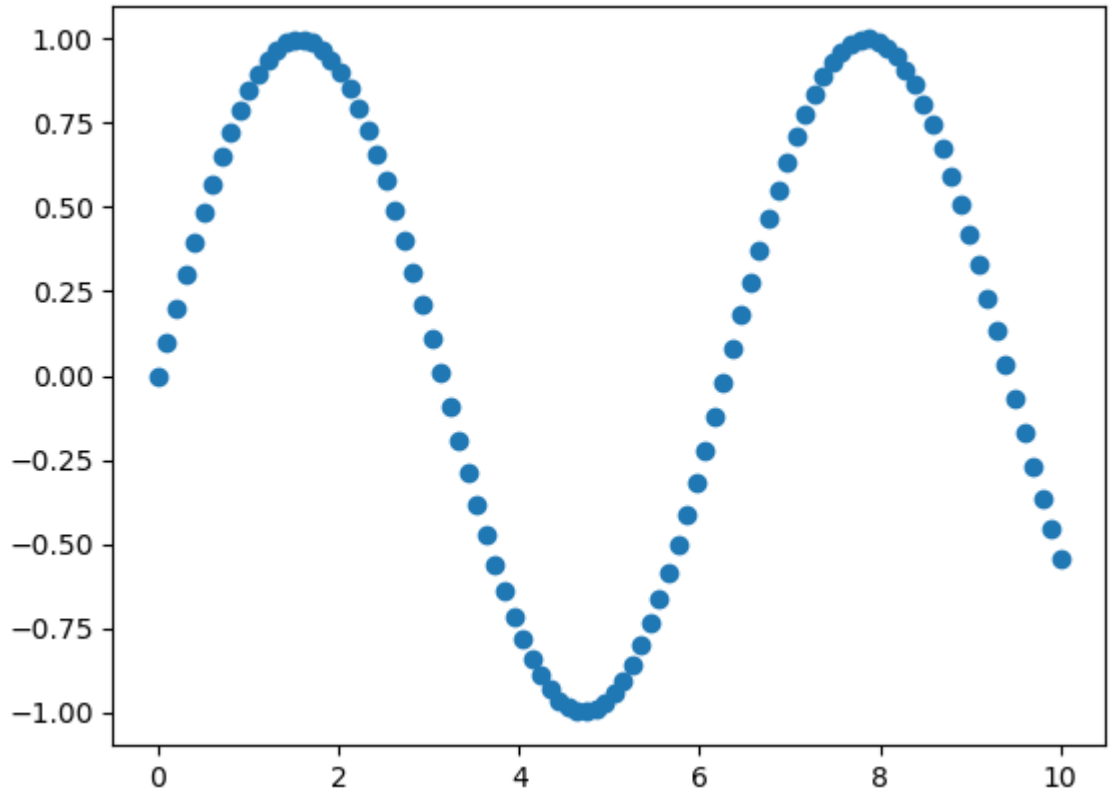
In [16]:
```
#  plot the data and create a line plot
fig, ax = plt.subplots()
ax.plot(x, x**2);
```




In [17]:
```
# use same data to make a scatter plot
fig, ax = plt.subplots()
ax.scatter(x, np.exp(x));
```

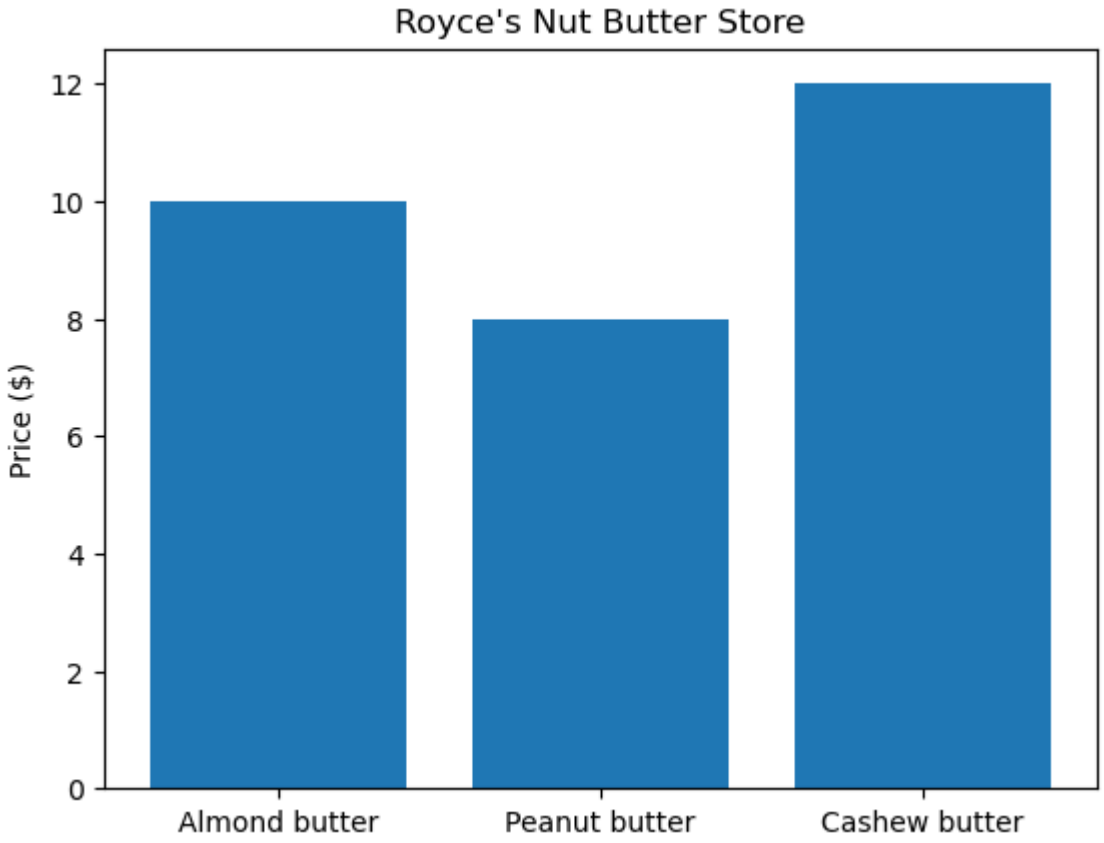



In [18]:
```
# another scatter plot
fig, ax = plt.subplots()
ax.scatter(x, np.sin(x));
```

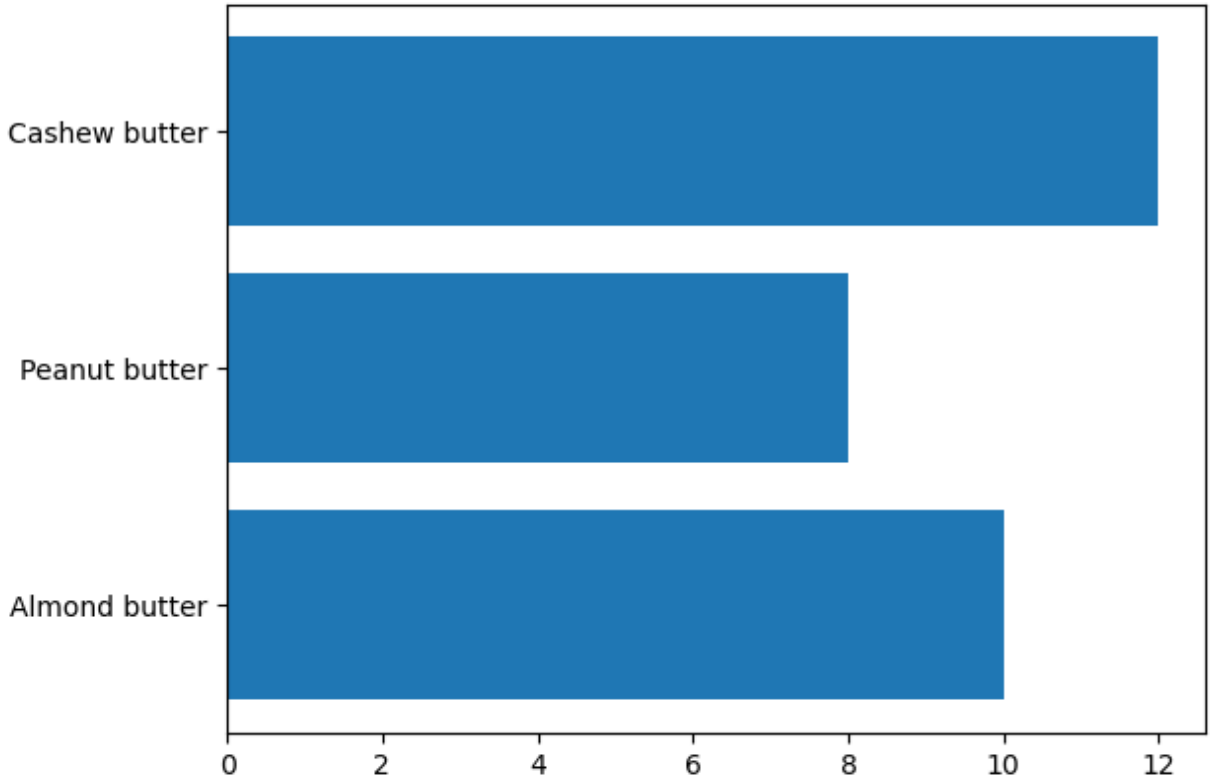



In [19]:
```
# make a plot from dictionary
nut_butter_prices = {'Almond butter': 10,
                     'Peanut butter': 8,
```

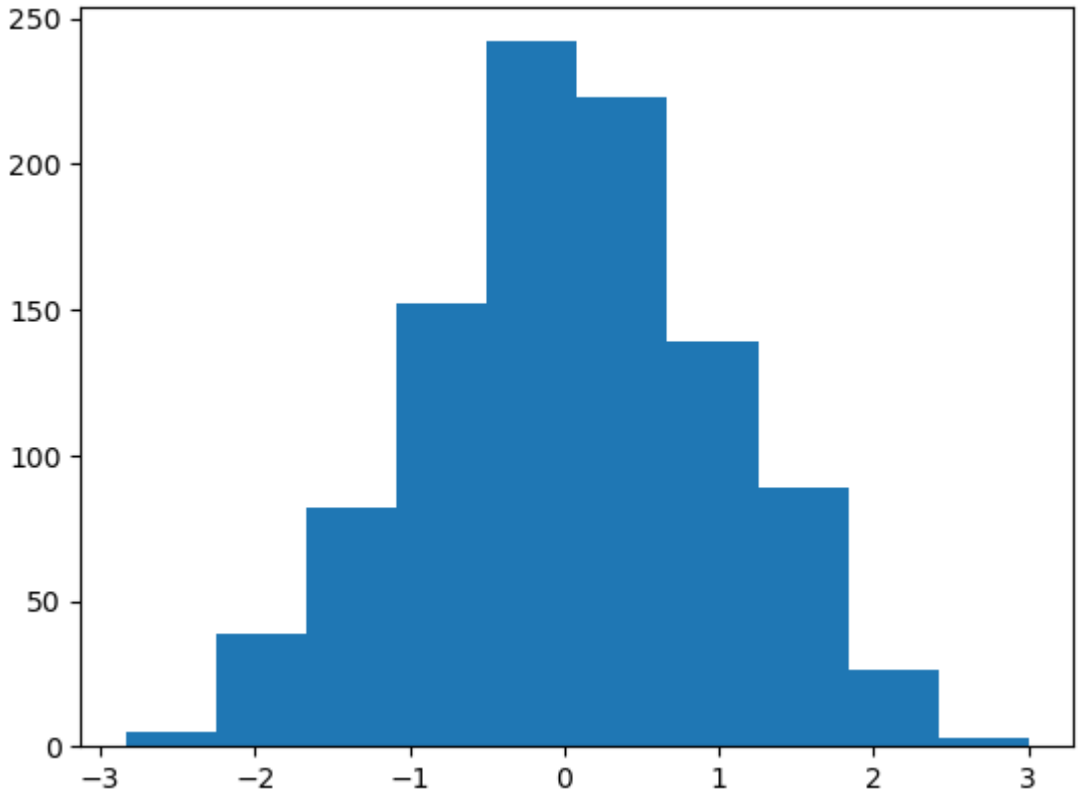
```
                    'Cashew butter': 12}
fig, ax = plt.subplots()
ax.bar(nut_butter_prices.keys(),  nut_butter_prices.values())
ax.set(title = "Royce's Nut Butter Store",
       ylabel = 'Price ($)'
    );
```




In [20]:
```
fig, ax = plt.subplots()
ax.barh(list(nut_butter_prices.keys()), list(nut_butter_prices.values()));
```

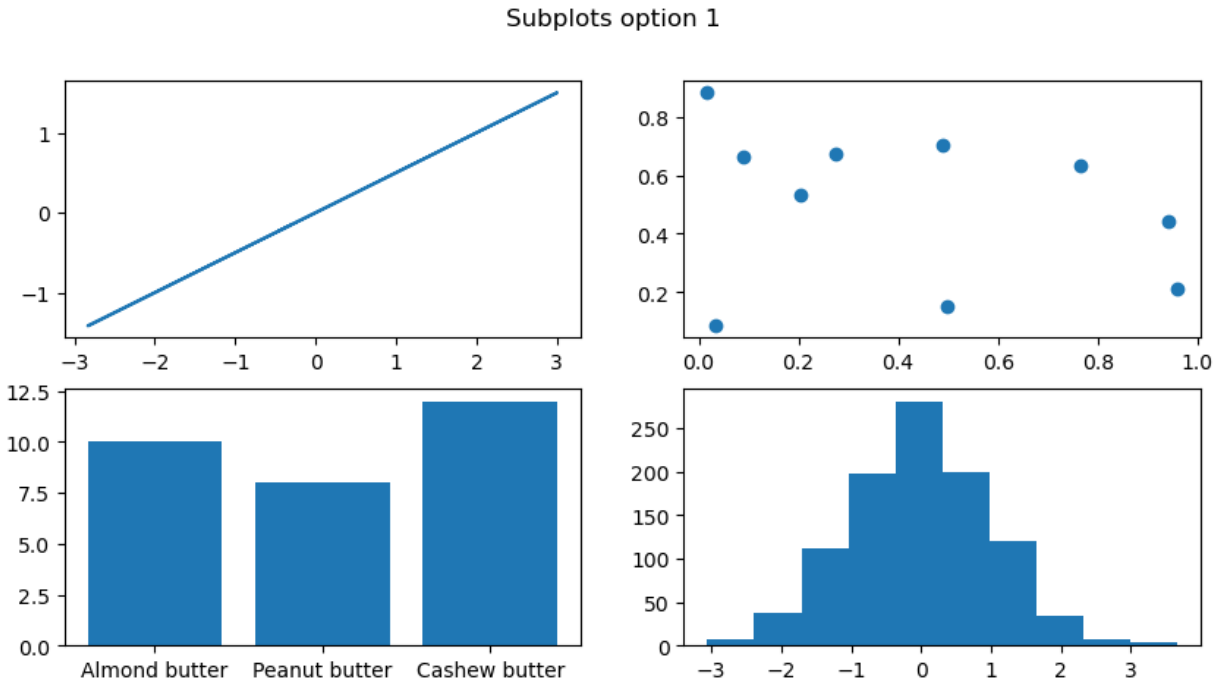



In [21]:
```
# make saome data for histograms and plot it
x = np.random.randn(1000)
fig, ax = plt.subplots()
ax.hist(x);
```

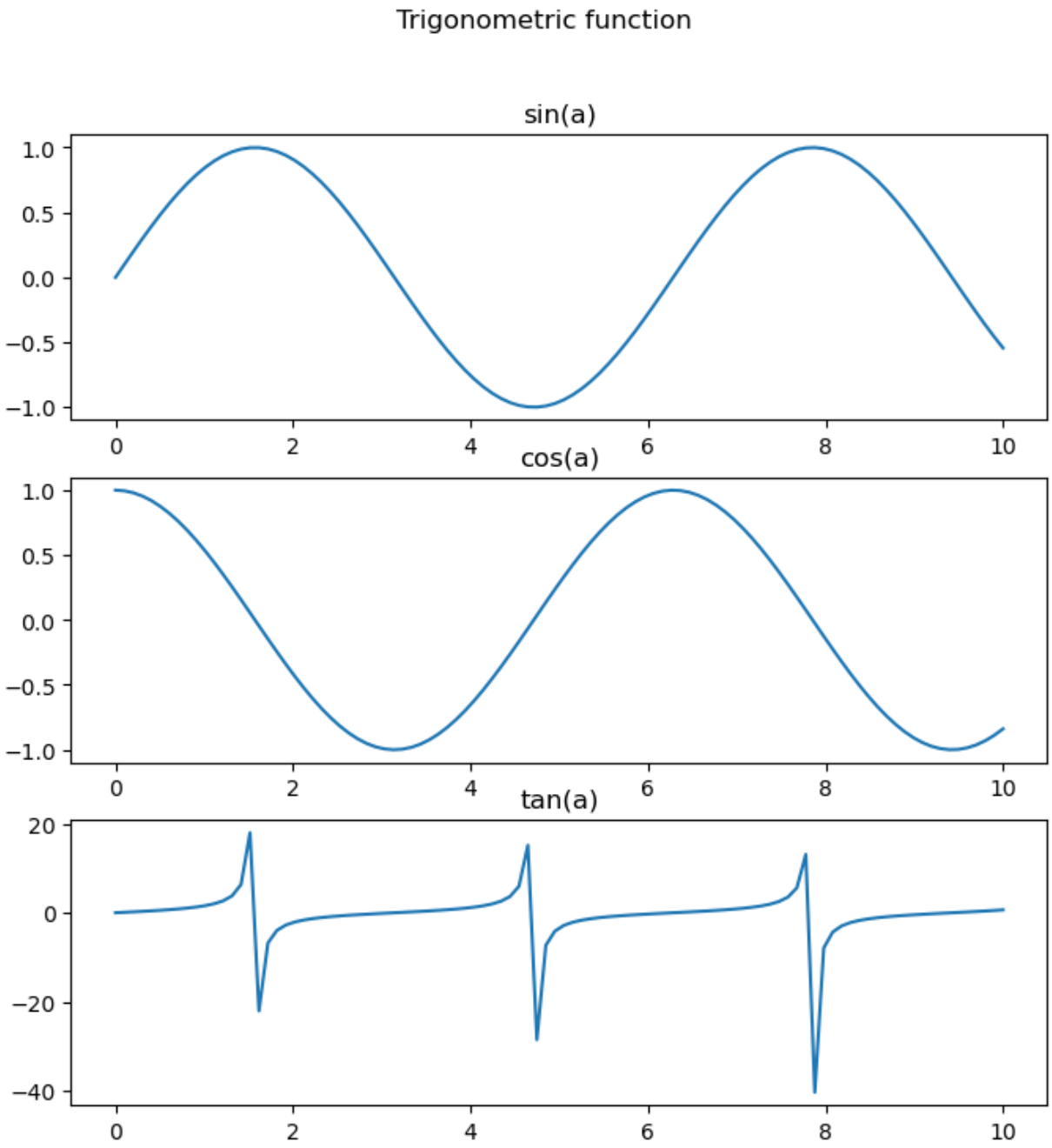



# Two options for subplots

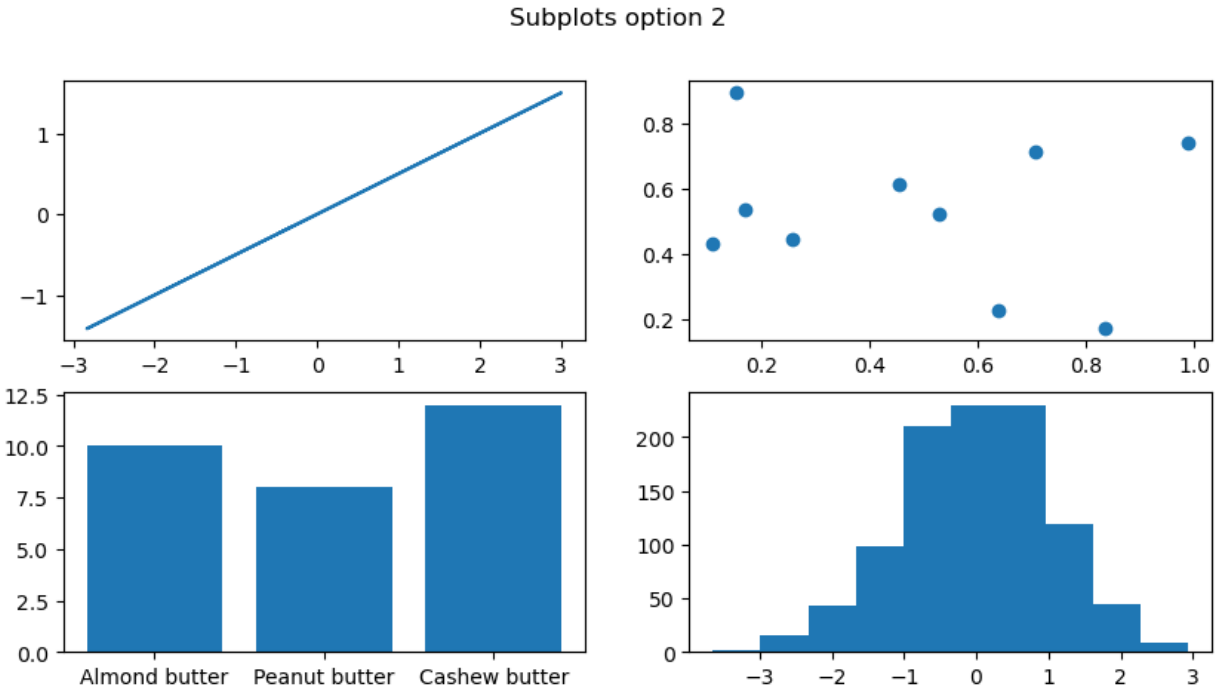
In [22]:
```
# subplot option 1
fig, ((ax1, ax2), (ax3, ax4)) = plt.subplots(nrows = 2,
                                             ncols = 2,
                                             figsize = (10, 5))
# plot to each different axis
ax1.plot(x, x/2);
ax2.scatter(np.random.random(10), np.random.random(10));
ax3.bar(nut_butter_prices.keys(), nut_butter_prices.values());
ax4.hist(np.random.randn(1000));
fig.suptitle('Subplots option 1');
```




In [23]:
```
a = np.linspace(0, 10, 100)
y1 = np.sin(a)
y2 = np.cos(a)
y3 = np.tan(a)

fig, ax = plt.subplots(3, 1, figsize = (8, 8))
ax[0].plot(a, y1)
ax[1].plot(a, y2)
ax[2].plot(a, y3)

ax[0].set_title('sin(a)')
ax[1].set_title('cos(a)')
ax[2].set_title('tan(a)')
fig.suptitle('Trigonometric function')

plt.show()
```




In [24]:
```
# subplot option 2
fig, ax = plt.subplots(nrows = 2,
                       ncols = 2,
                       figsize = (10, 5))
# plot to each different index
ax[0, 0].plot(x, x/2);
ax[0, 1].scatter(np.random.random(10), np.random.random(10));
ax[1, 0].bar(nut_butter_prices.keys(), nut_butter_prices.values());
ax[1, 1].hist(np.random.randn(1000));
fig.suptitle('Subplots option 2');
```




# Plotting from pandas Dataframe

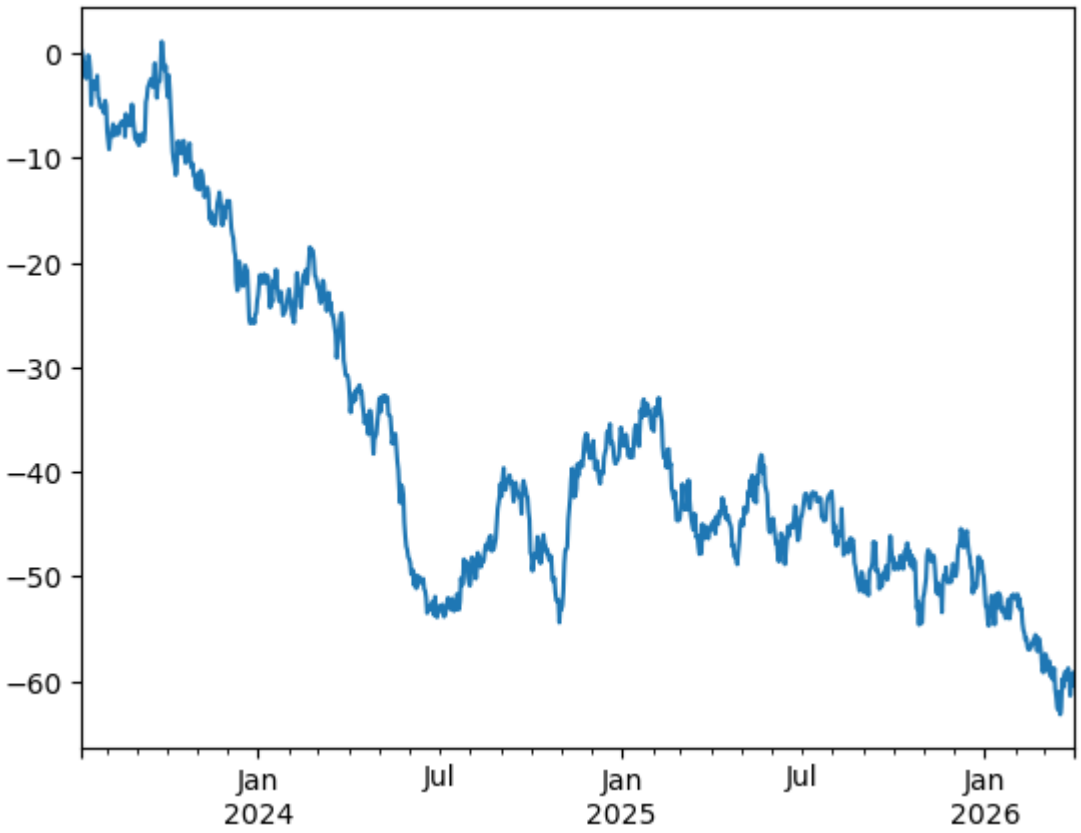
In [25]:
```
import pandas as pd
```

In [26]:
```
# make a dataframe
car_sales = pd.read_csv('car-sales.csv')
car_sales
```

Out[26]:

| | Make | Colour | Odometer (KM) | Doors | Price |
|---|---|---|---|---|---|
| **0** | Toyota | White | 150043 | 4 | $4,000.00 |
| **1** | Honda | Red | 87899 | 4 | $5,000.00 |
| **2** | Toyota | Blue | 32549 | 3 | $7,000.00 |
| **3** | BMW | Black | 11179 | 5 | $22,000.00 |
| **4** | Nissan | White | 213095 | 4 | $3,500.00 |
| **5** | Toyota | Green | 99213 | 4 | $4,500.00 |
| **6** | Honda | Blue | 45698 | 4 | $7,500.00 |
| **7** | Honda | Blue | 54738 | 4 | $7,000.00 |
| **8** | Toyota | White | 60000 | 4 | $6,250.00 |
| **9** | Nissan | White | 31600 | 4 | $9,700.00 |

In [27]:
```
ts = pd.Series(np.random.randn(1000),
               index = pd.date_range('7/7/2023', periods = 1000))
ts = ts.cumsum()
ts.plot();
```




In [28]:
```
car_sales
```

Out[28]:

| | Make | Colour | Odometer (KM) | Doors | Price |
|---|---|---|---|---|---|
| **0** | Toyota | White | 150043 | 4 | $4,000.00 |
| **1** | Honda | Red | 87899 | 4 | $5,000.00 |
| **2** | Toyota | Blue | 32549 | 3 | $7,000.00 |
| **3** | BMW | Black | 11179 | 5 | $22,000.00 |
| **4** | Nissan | White | 213095 | 4 | $3,500.00 |
| **5** | Toyota | Green | 99213 | 4 | $4,500.00 |
| **6** | Honda | Blue | 45698 | 4 | $7,500.00 |
| **7** | Honda | Blue | 54738 | 4 | $7,000.00 |
| **8** | Toyota | White | 60000 | 4 | $6,250.00 |
| **9** | Nissan | White | 31600 | 4 | $9,700.00 |

In [29]:
```
car_sales['Price'] = car_sales['Price'].str.replace('[\$\,\.]', '')
car_sales
```

```
C:\Users\USER\AppData\Local\Temp\ipykernel_4244\1919509590.py:1: FutureWarning: The def
ault value of regex will change from True to False in a future version.
  car_sales['Price'] = car_sales['Price'].str.replace('[\$\,\.]', '')
```

Out[29]:

| | Make | Colour | Odometer (KM) | Doors | Price |
|---|---|---|---|---|---|
| **0** | Toyota | White | 150043 | 4 | 400000 |
| **1** | Honda | Red | 87899 | 4 | 500000 |
| **2** | Toyota | Blue | 32549 | 3 | 700000 |
| **3** | BMW | Black | 11179 | 5 | 2200000 |
| **4** | Nissan | White | 213095 | 4 | 350000 |
| **5** | Toyota | Green | 99213 | 4 | 450000 |
| **6** | Honda | Blue | 45698 | 4 | 750000 |
| **7** | Honda | Blue | 54738 | 4 | 700000 |
| **8** | Toyota | White | 60000 | 4 | 625000 |
| **9** | Nissan | White | 31600 | 4 | 970000 |

In [30]:
```
type(car_sales['Price'][0])
```

Out[30]:
```
str
```

In [31]:
```
# Remove last two zeros
car_sales['Price'] = car_sales['Price'].str[:-3]
car_sales
```

Out[31]:

| | Make | Colour | Odometer (KM) | Doors | Price |
|---|---|---|---|---|---|
| **0** | Toyota | White | 150043 | 4 | 4000 |
| **1** | Honda | Red | 87899 | 4 | 5000 |
| **2** | Toyota | Blue | 32549 | 3 | 7000 |
| **3** | BMW | Black | 11179 | 5 | 22000 |
| **4** | Nissan | White | 213095 | 4 | 3500 |
| **5** | Toyota | Green | 99213 | 4 | 4500 |
| **6** | Honda | Blue | 45698 | 4 | 7500 |
| **7** | Honda | Blue | 54738 | 4 | 7000 |
| **8** | Toyota | White | 60000 | 4 | 6250 |
| **9** | Nissan | White | 31600 | 4 | 9700 |

In [32]:
```
car_sales['Sale Date'] = pd.date_range('3/7/2023', periods = len(car_sales))
car_sales
```

Out[32]:

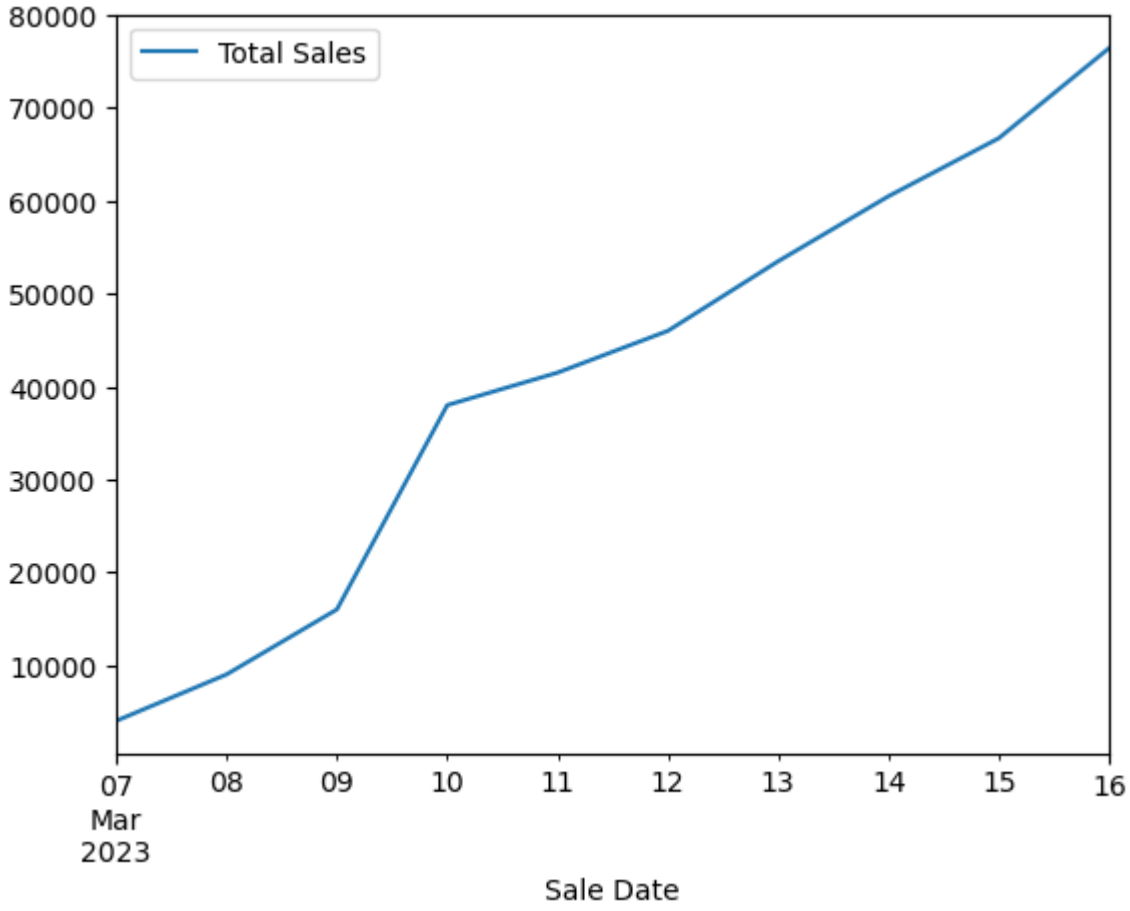
| | Make | Colour | Odometer (KM) | Doors | Price | Sale Date |
|---|---|---|---|---|---|---|
| **0** | Toyota | White | 150043 | 4 | 4000 | 2023-03-07 |
| **1** | Honda | Red | 87899 | 4 | 5000 | 2023-03-08 |
| **2** | Toyota | Blue | 32549 | 3 | 7000 | 2023-03-09 |
| **3** | BMW | Black | 11179 | 5 | 22000 | 2023-03-10 |
| **4** | Nissan | White | 213095 | 4 | 3500 | 2023-03-11 |
| **5** | Toyota | Green | 99213 | 4 | 4500 | 2023-03-12 |
| **6** | Honda | Blue | 45698 | 4 | 7500 | 2023-03-13 |
| **7** | Honda | Blue | 54738 | 4 | 7000 | 2023-03-14 |
| **8** | Toyota | White | 60000 | 4 | 6250 | 2023-03-15 |
| **9** | Nissan | White | 31600 | 4 | 9700 | 2023-03-16 |

In [33]:
```
car_sales['Total Sales'] = car_sales['Price'].astype(int).cumsum()
car_sales
```

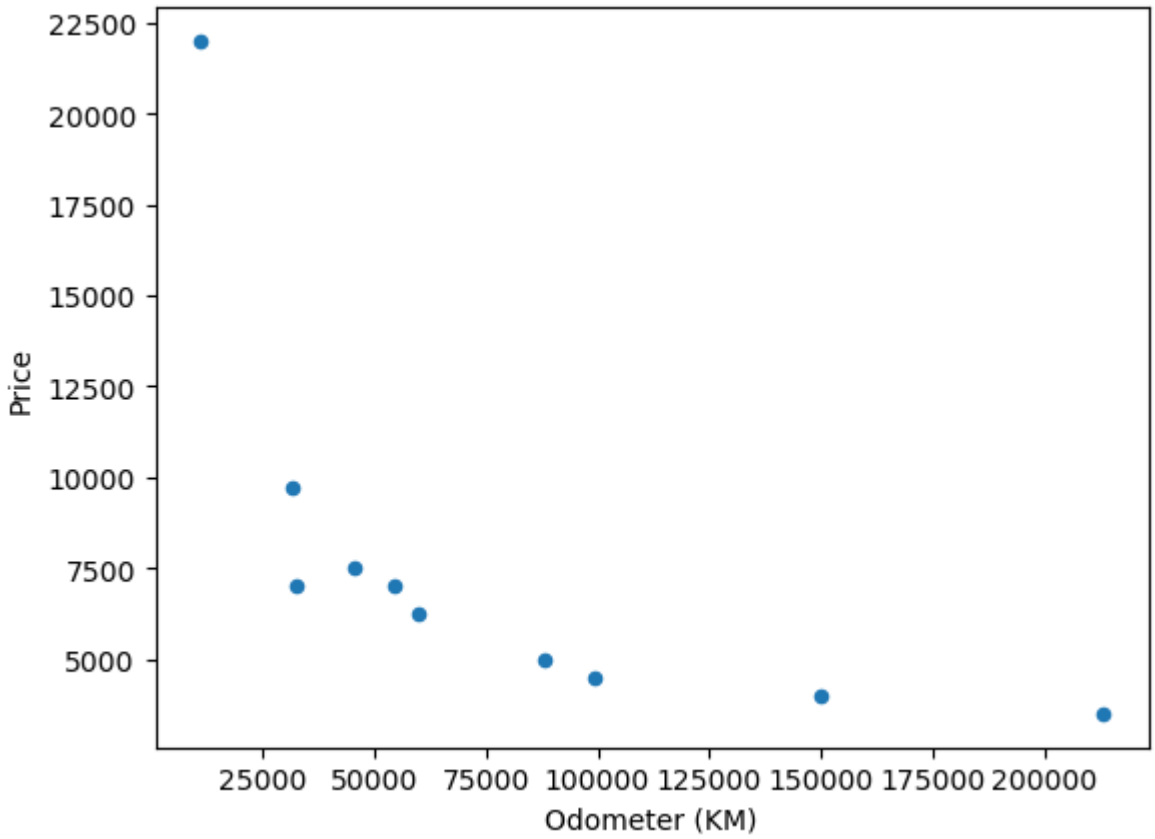
Out[33]:

| | Make | Colour | Odometer (KM) | Doors | Price | Sale Date | Total Sales |
|---|---|---|---|---|---|---|---|
| **0** | Toyota | White | 150043 | 4 | 4000 | 2023-03-07 | 4000 |
| **1** | Honda | Red | 87899 | 4 | 5000 | 2023-03-08 | 9000 |
| **2** | Toyota | Blue | 32549 | 3 | 7000 | 2023-03-09 | 16000 |
| **3** | BMW | Black | 11179 | 5 | 22000 | 2023-03-10 | 38000 |
| **4** | Nissan | White | 213095 | 4 | 3500 | 2023-03-11 | 41500 |
| **5** | Toyota | Green | 99213 | 4 | 4500 | 2023-03-12 | 46000 |
| **6** | Honda | Blue | 45698 | 4 | 7500 | 2023-03-13 | 53500 |
| **7** | Honda | Blue | 54738 | 4 | 7000 | 2023-03-14 | 60500 |
| **8** | Toyota | White | 60000 | 4 | 6250 | 2023-03-15 | 66750 |
| **9** | Nissan | White | 31600 | 4 | 9700 | 2023-03-16 | 76450 |

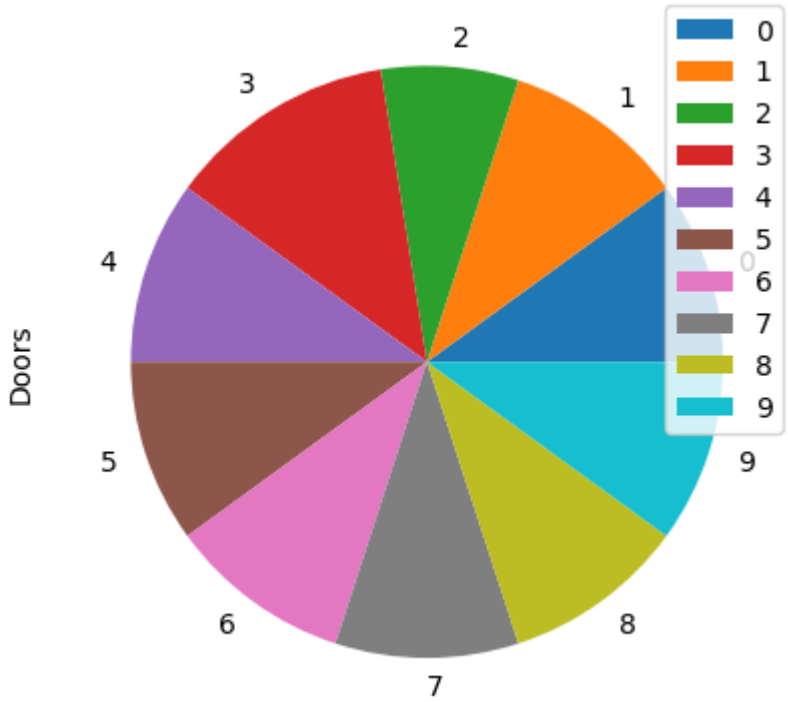
In [34]:
```
# Let's plot the total sales
car_sales.plot(x = 'Sale Date', y = 'Total Sales' );
```



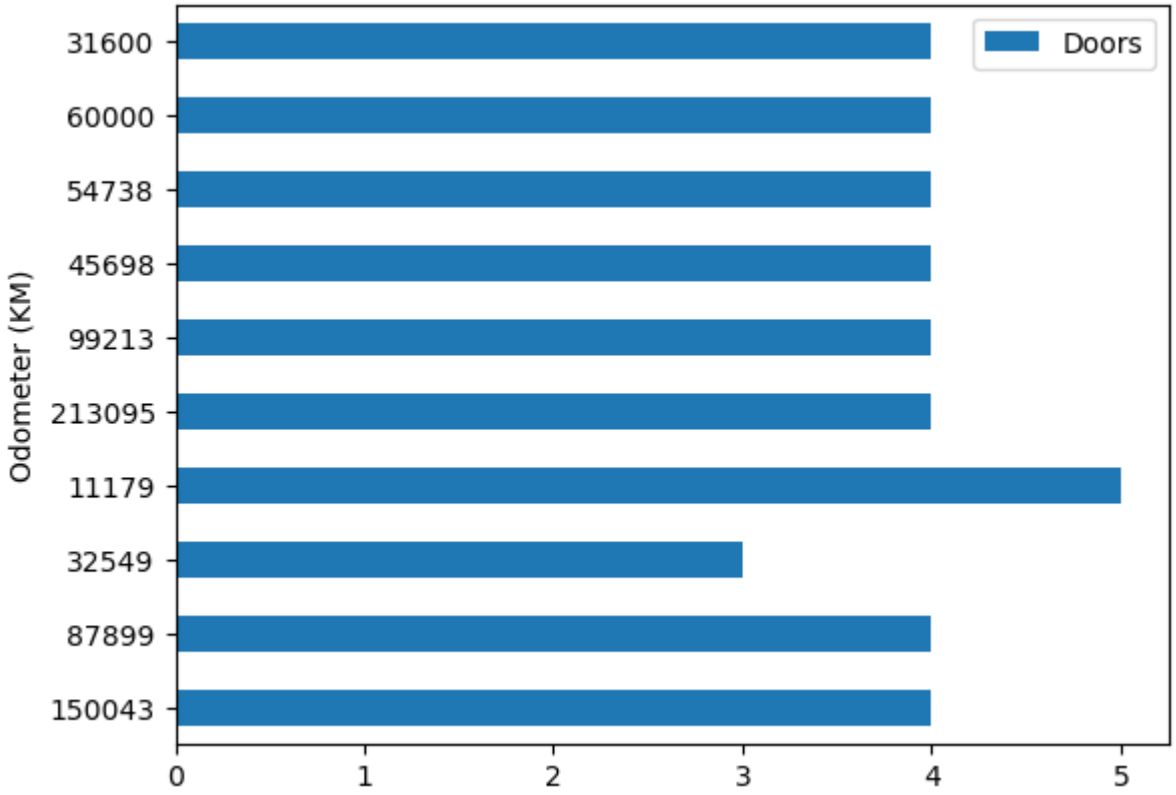

In [35]:
```
# reasssign price column to int
car_sales['Price'] = car_sales['Price'].astype(int)
# plot scatter plot with price column as numeric
car_sales.plot(x = 'Odometer (KM)', y = 'Price', kind = 'scatter' );
```




In [36]:
```
car_sales.plot(x = 'Odometer (KM)', y = 'Doors', kind = 'pie');
```




In [37]:
```
car_sales.plot.barh(x = 'Odometer (KM)', y = 'Doors');
```

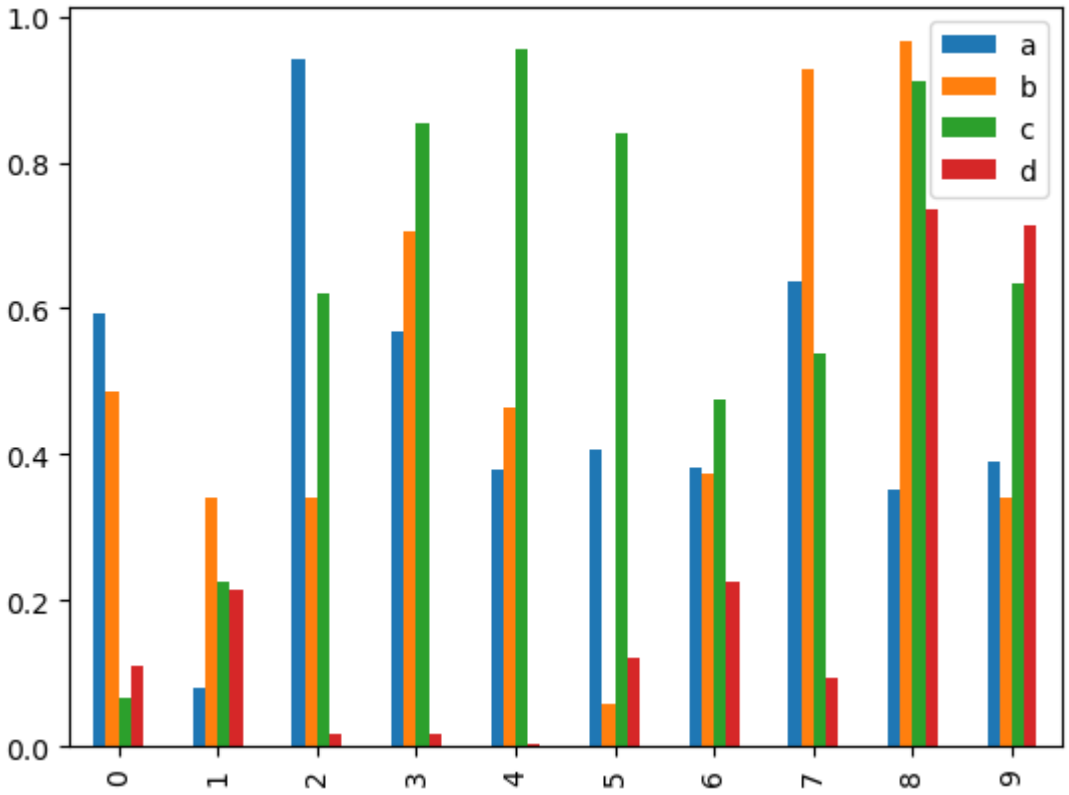



In [38]:
```
# how about a bar graph?
x = np.random.rand(10, 4)
x

# turn it into dataframe
df = pd.DataFrame(x, columns = ['a', 'b', 'c', 'd'])
df
```

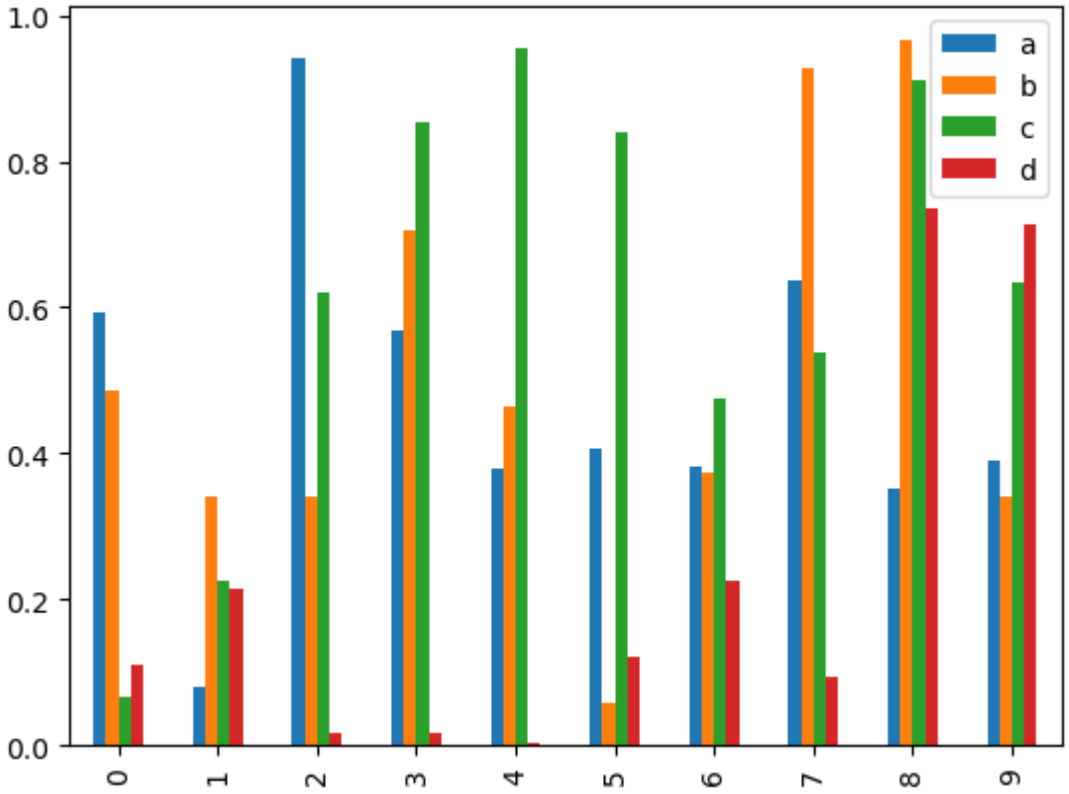
Out[38]:

| | a | b | c | d |
|---|---|---|---|---|
| **0** | 0.591815 | 0.486991 | 0.067487 | 0.111408 |
| **1** | 0.081034 | 0.340652 | 0.225377 | 0.215755 |
| **2** | 0.942504 | 0.341506 | 0.619570 | 0.016577 |
| **3** | 0.569377 | 0.706299 | 0.852829 | 0.016550 |
| **4** | 0.379459 | 0.464918 | 0.954074 | 0.004423 |
| **5** | 0.405682 | 0.057585 | 0.840485 | 0.121816 |
| **6** | 0.381980 | 0.372578 | 0.474989 | 0.226547 |
| **7** | 0.637801 | 0.927939 | 0.538354 | 0.095417 |
| **8** | 0.351002 | 0.964709 | 0.911392 | 0.734984 |
| **9** | 0.390596 | 0.341008 | 0.634193 | 0.714806 |

In [39]:
```
df.plot.bar();
```




In [40]:
```
df.plot(kind = 'bar');
```

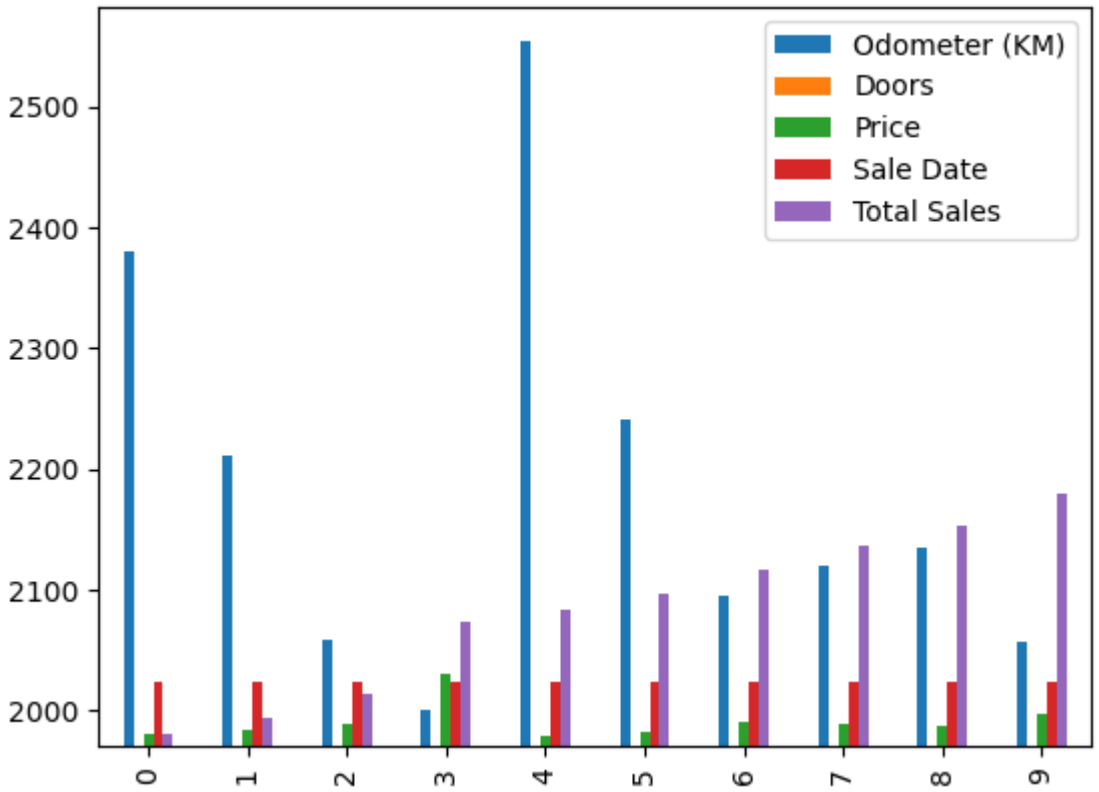



In [41]:
```
car_sales
```

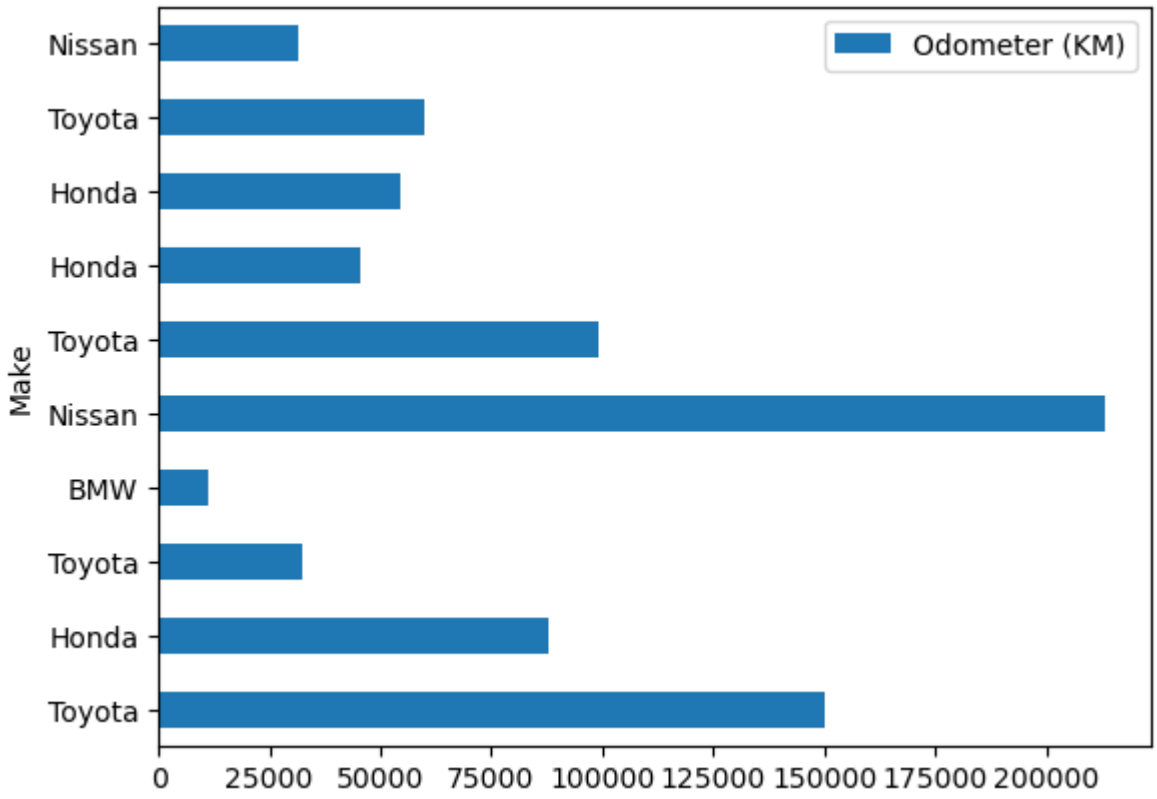
Out[41]:

| | Make | Colour | Odometer (KM) | Doors | Price | Sale Date | Total Sales |
|---|---|---|---|---|---|---|---|
| **0** | Toyota | White | 150043 | 4 | 4000 | 2023-03-07 | 4000 |
| **1** | Honda | Red | 87899 | 4 | 5000 | 2023-03-08 | 9000 |
| **2** | Toyota | Blue | 32549 | 3 | 7000 | 2023-03-09 | 16000 |
| **3** | BMW | Black | 11179 | 5 | 22000 | 2023-03-10 | 38000 |
| **4** | Nissan | White | 213095 | 4 | 3500 | 2023-03-11 | 41500 |
| **5** | Toyota | Green | 99213 | 4 | 4500 | 2023-03-12 | 46000 |
| **6** | Honda | Blue | 45698 | 4 | 7500 | 2023-03-13 | 53500 |
| **7** | Honda | Blue | 54738 | 4 | 7000 | 2023-03-14 | 60500 |
| **8** | Toyota | White | 60000 | 4 | 6250 | 2023-03-15 | 66750 |
| **9** | Nissan | White | 31600 | 4 | 9700 | 2023-03-16 | 76450 |

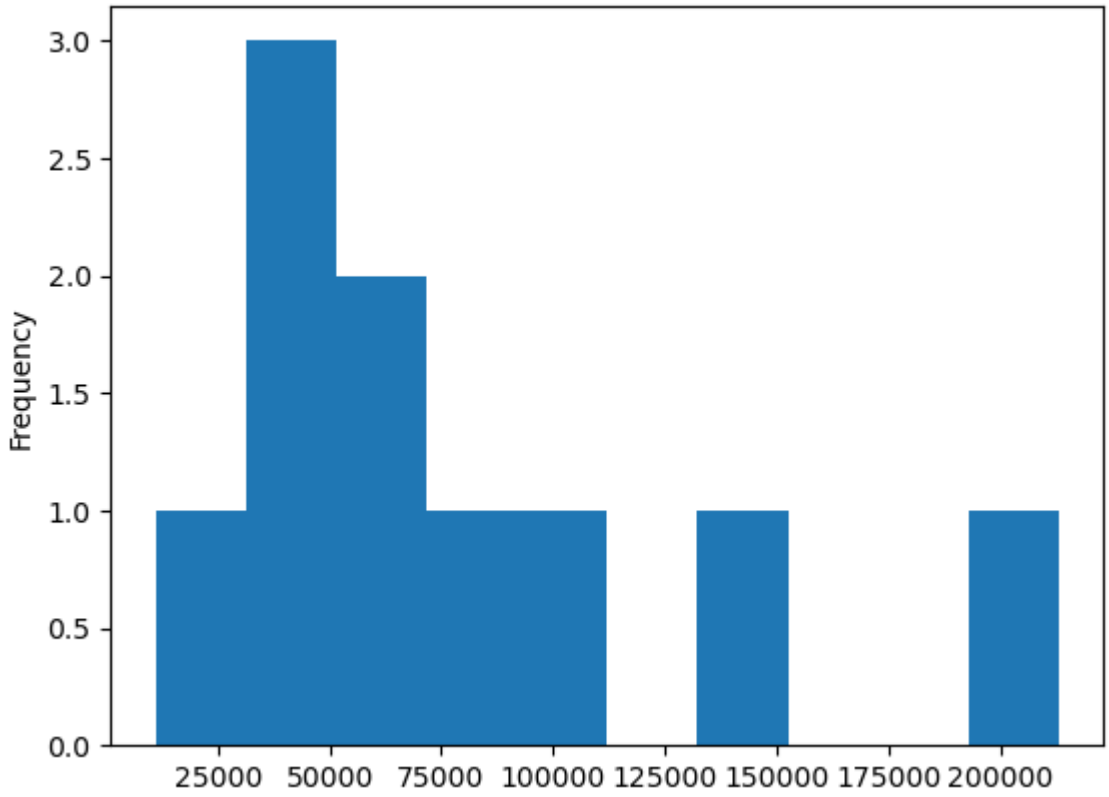
In [42]:
```
car_sales.plot.bar();
```



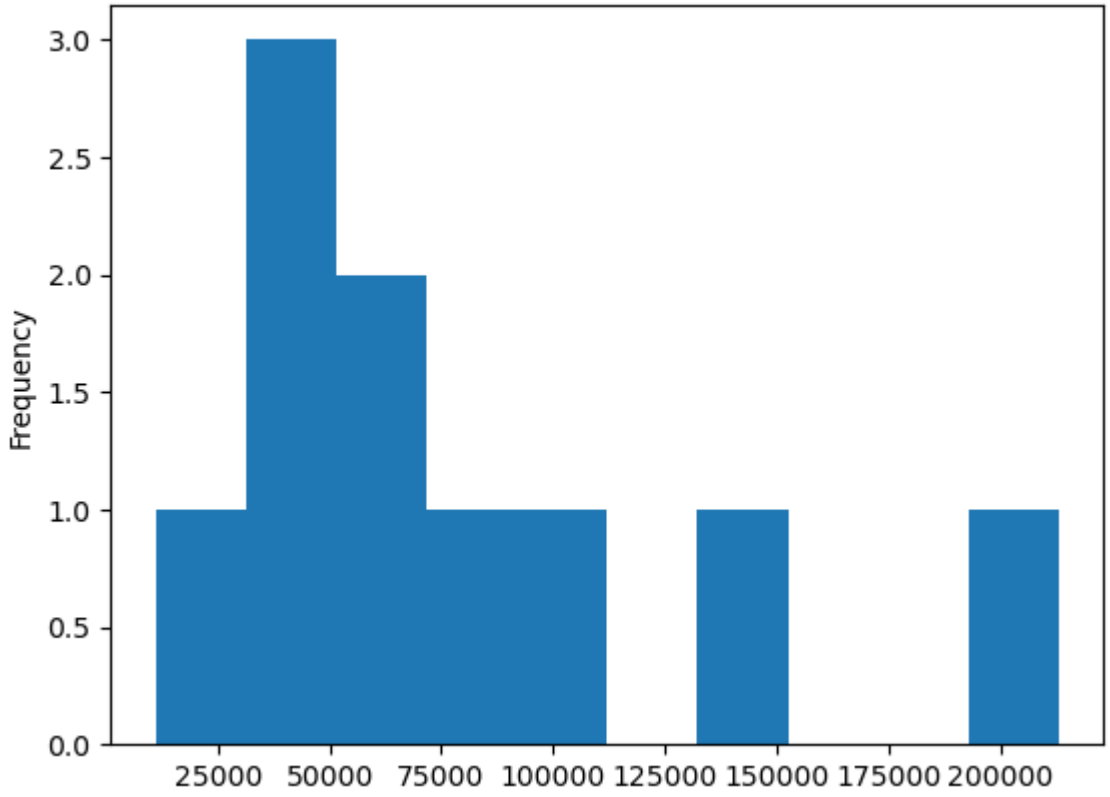

In [43]:
```
car_sales.plot(x ='Make', y = 'Odometer (KM)', kind ='barh');
```



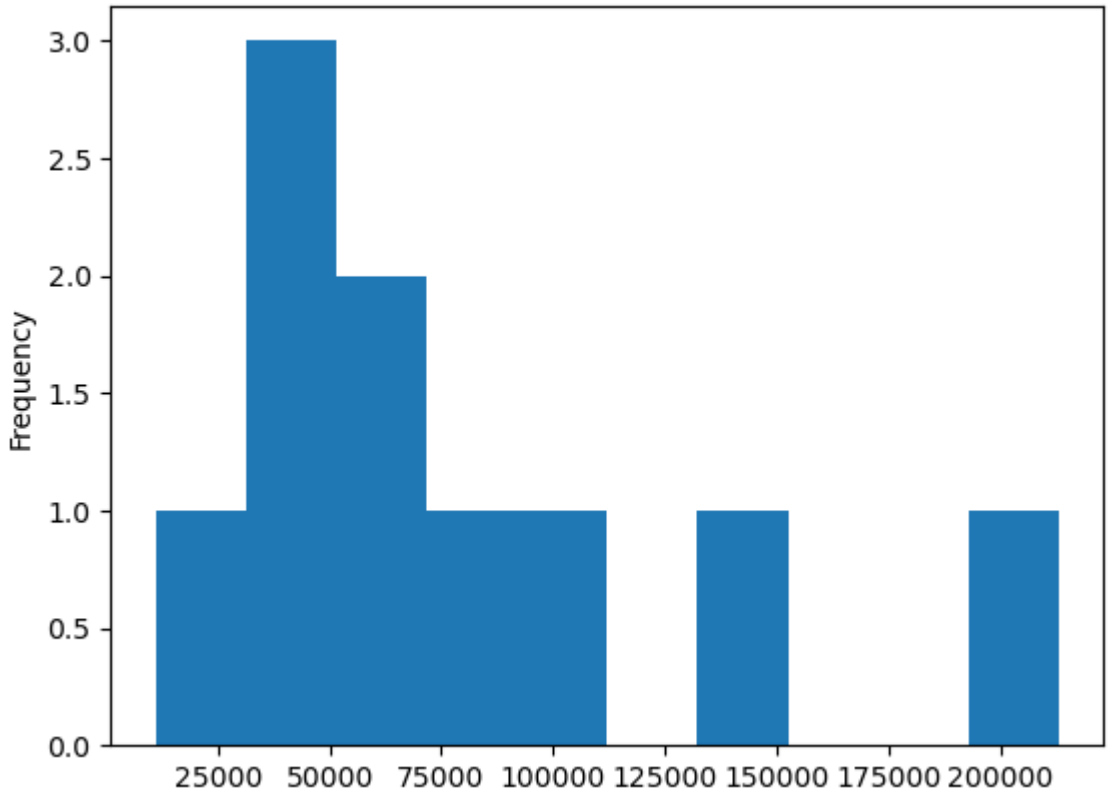

In [44]:
```
# how about histograms
car_sales['Odometer (KM)'].plot.hist();
```




In [45]:
```
car_sales['Odometer (KM)'].plot(kind ='hist');
```




In [46]:
```
car_sales['Odometer (KM)'].plot(bins = 10, kind ='hist');
```

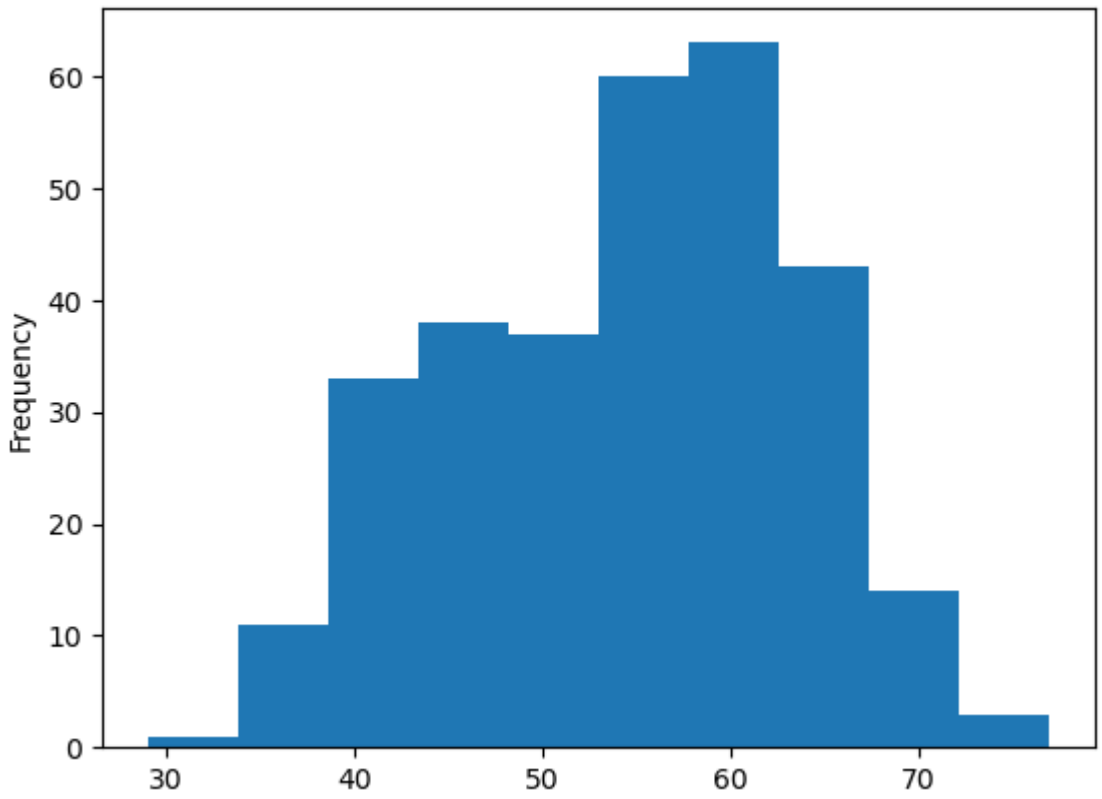



In [47]:
```
# let's try on another dataset
heart_disease = pd.read_csv('heart-disease.csv')
heart_disease.head()
```

Out[47]:

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 63 | 1 | 3 | 145 | 233 | 1 | 0 | 150 | 0 | 2.3 | 0 | 0 | 1 | 1 |
| **1** | 37 | 1 | 2 | 130 | 250 | 0 | 1 | 187 | 0 | 3.5 | 0 | 0 | 2 | 1 |
| **2** | 41 | 0 | 1 | 130 | 204 | 0 | 0 | 172 | 0 | 1.4 | 2 | 0 | 2 | 1 |
| **3** | 56 | 1 | 1 | 120 | 236 | 0 | 1 | 178 | 0 | 0.8 | 2 | 0 | 2 | 1 |
| **4** | 57 | 0 | 0 | 120 | 354 | 0 | 1 | 163 | 1 | 0.6 | 2 | 0 | 2 | 1 |

In [48]:
```
# create a histogram
heart_disease['age'].plot.hist();
```

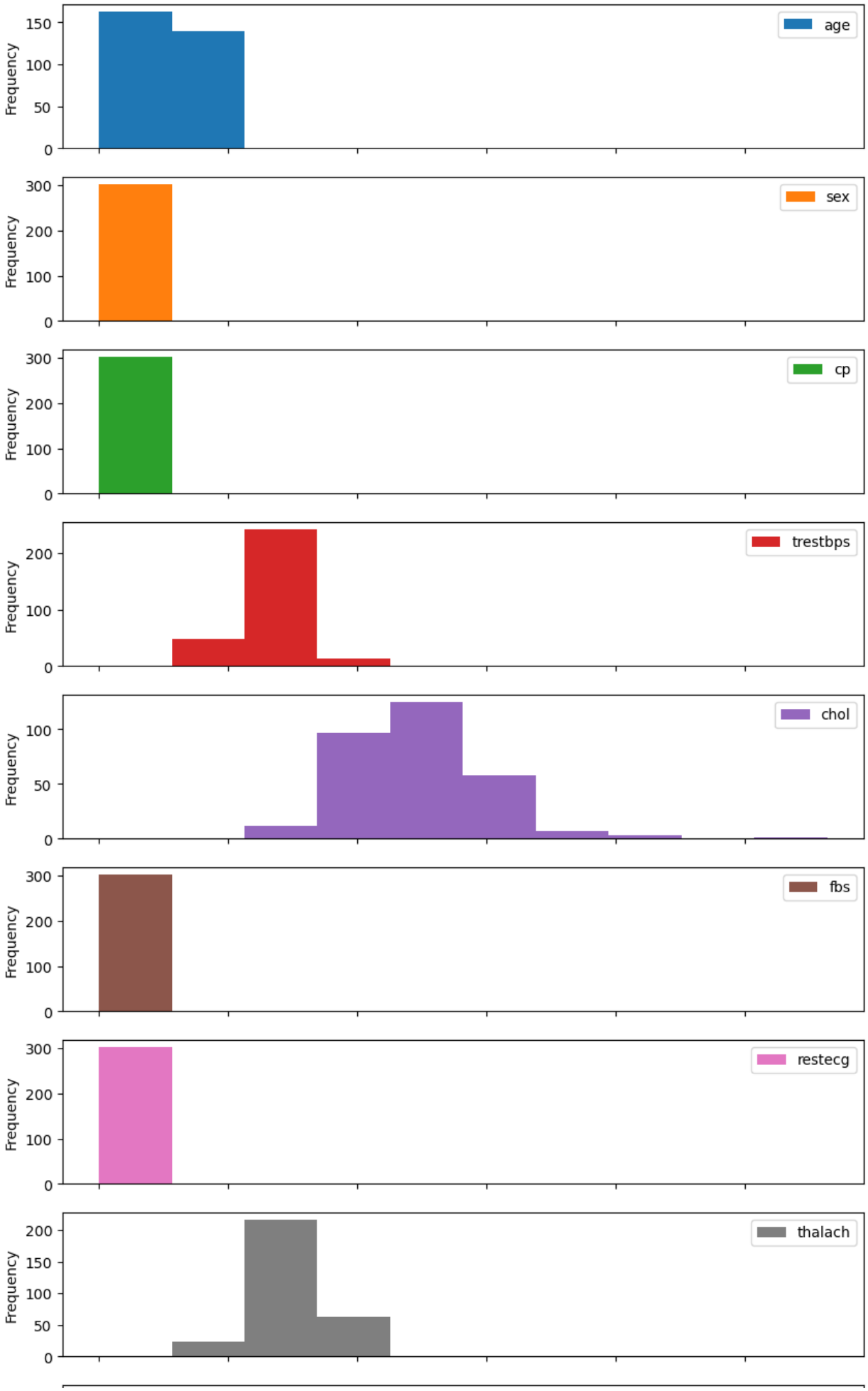


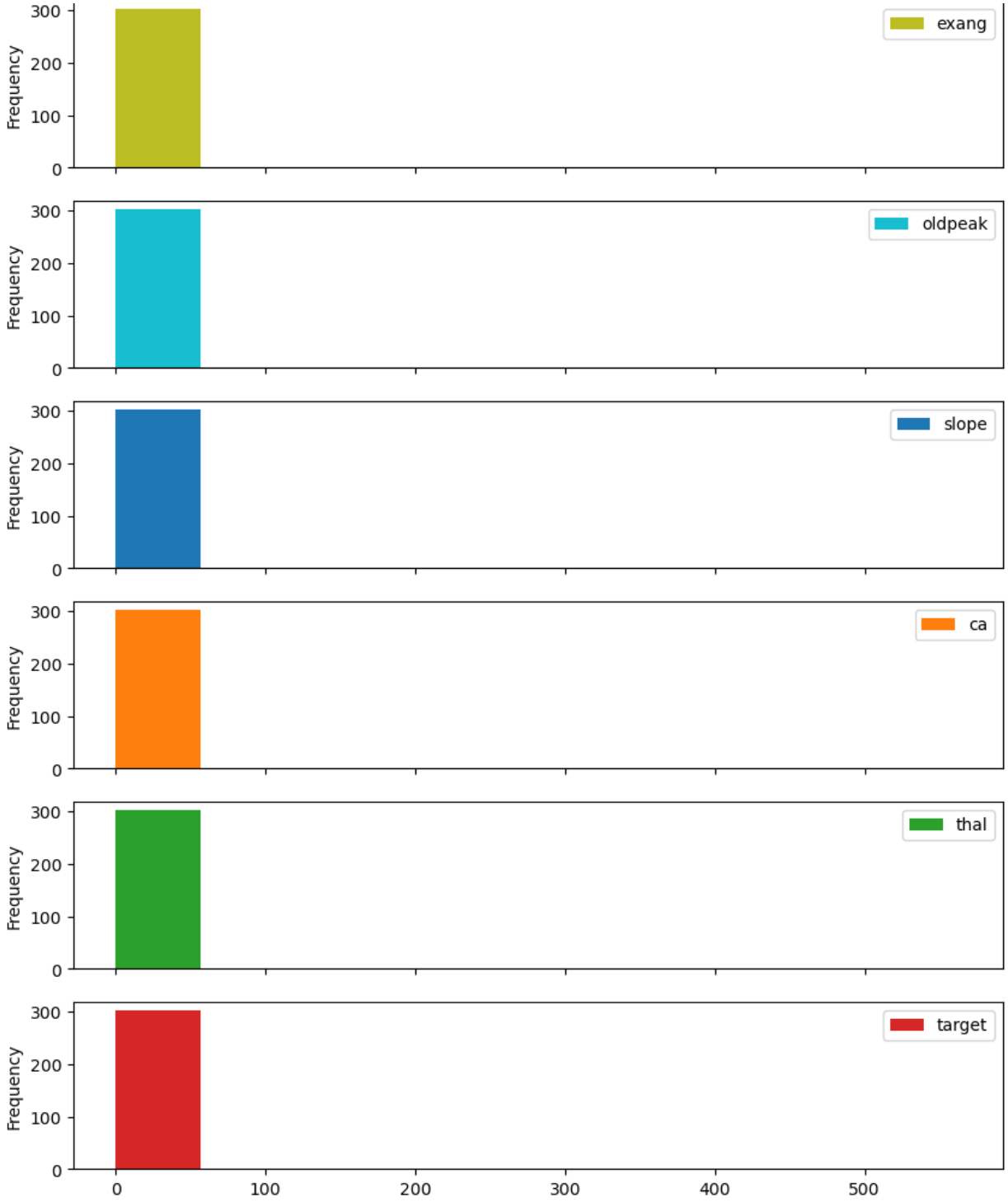

In [49]:
```
heart_disease.head()
```

Out[49]:

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 63 | 1 | 3 | 145 | 233 | 1 | 0 | 150 | 0 | 2.3 | 0 | 0 | 1 | 1 |
| **1** | 37 | 1 | 2 | 130 | 250 | 0 | 1 | 187 | 0 | 3.5 | 0 | 0 | 2 | 1 |
| **2** | 41 | 0 | 1 | 130 | 204 | 0 | 0 | 172 | 0 | 1.4 | 2 | 0 | 2 | 1 |
| **3** | 56 | 1 | 1 | 120 | 236 | 0 | 1 | 178 | 0 | 0.8 | 2 | 0 | 2 | 1 |
| **4** | 57 | 0 | 0 | 120 | 354 | 0 | 1 | 163 | 1 | 0.6 | 2 | 0 | 2 | 1 |

In [50]:
```
heart_disease.plot.hist(figsize = (10, 30), subplots = True);
```


age
Frequency
sex
Frequency
cp
Frequency
trestbps
Frequency
chol
Frequency
fbs
Frequency
restecg
Frequency
thalach
Frequency




# which one should you use? (pyplot vs matplotlib OO method?)

1. when plotting something quickly, okay to use the pyplot method
2. when plotting something more advance, use the OO method

In [51]:
```
heart_disease.head()
```

Out[51]:

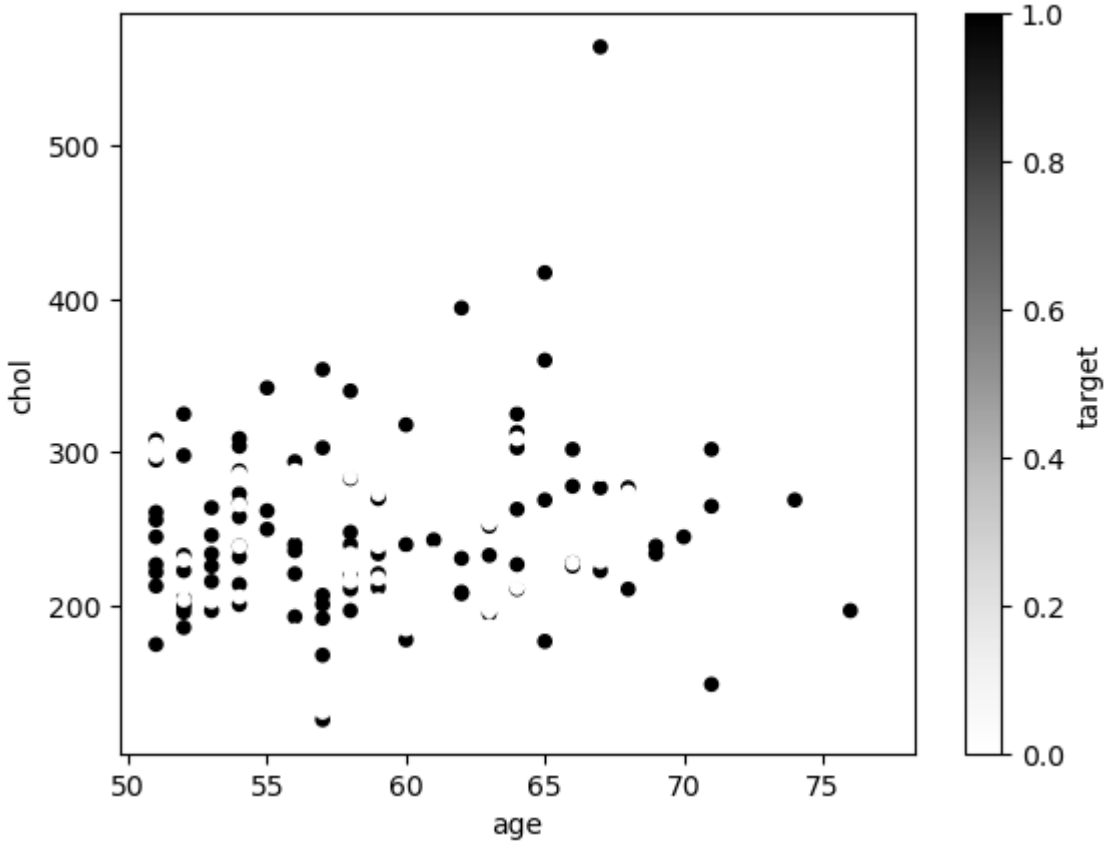
| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 63 | 1 | 3 | 145 | 233 | 1 | 0 | 150 | 0 | 2.3 | 0 | 0 | 1 | 1 |
| **1** | 37 | 1 | 2 | 130 | 250 | 0 | 1 | 187 | 0 | 3.5 | 0 | 0 | 2 | 1 |
| **2** | 41 | 0 | 1 | 130 | 204 | 0 | 0 | 172 | 0 | 1.4 | 2 | 0 | 2 | 1 |
| **3** | 56 | 1 | 1 | 120 | 236 | 0 | 1 | 178 | 0 | 0.8 | 2 | 0 | 2 | 1 |
| **4** | 57 | 0 | 0 | 120 | 354 | 0 | 1 | 163 | 1 | 0.6 | 2 | 0 | 2 | 1 |

In [52]:
```
over_50 = heart_disease[heart_disease['age'] > 50]
over_50.head()
```

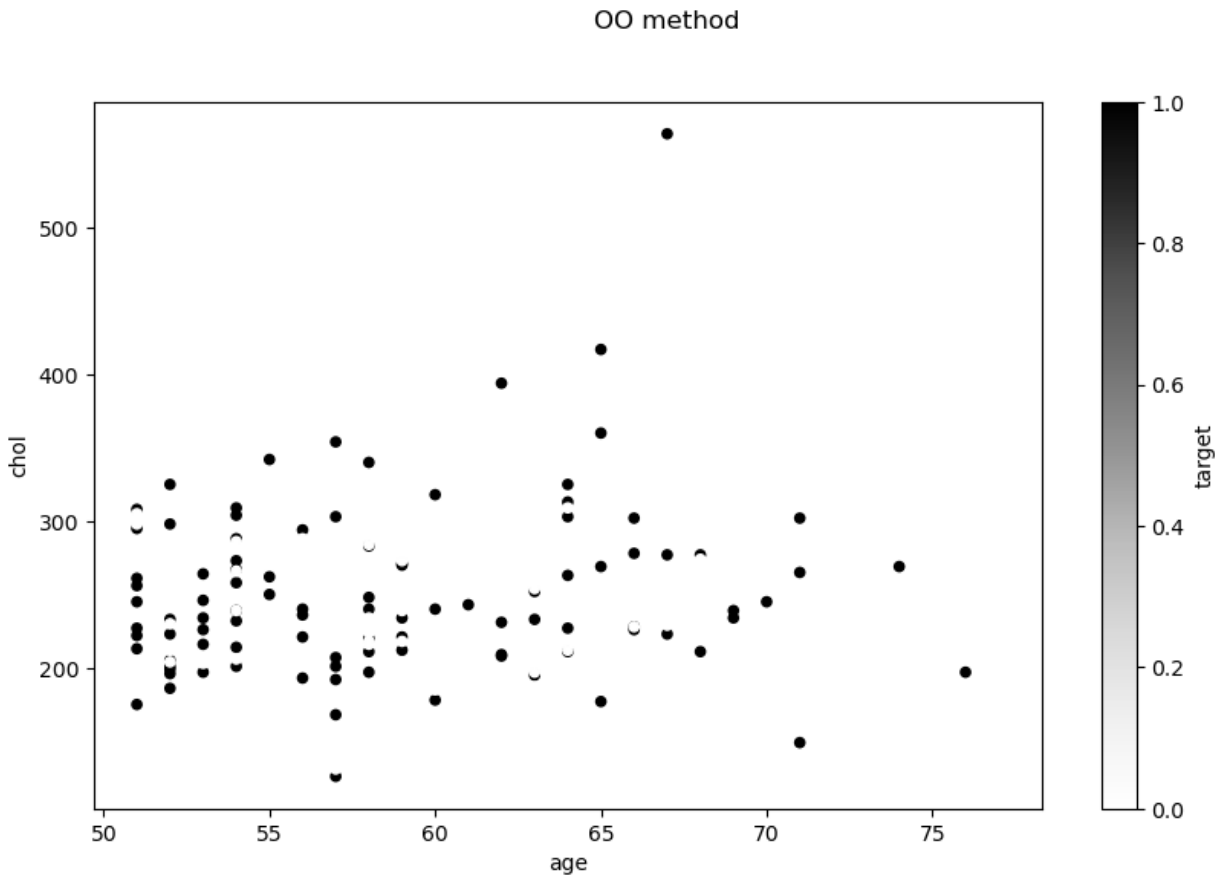
Out[52]:

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 63 | 1 | 3 | 145 | 233 | 1 | 0 | 150 | 0 | 2.3 | 0 | 0 | 1 | 1 |
| **3** | 56 | 1 | 1 | 120 | 236 | 0 | 1 | 178 | 0 | 0.8 | 2 | 0 | 2 | 1 |
| **4** | 57 | 0 | 0 | 120 | 354 | 0 | 1 | 163 | 1 | 0.6 | 2 | 0 | 2 | 1 |
| **5** | 57 | 1 | 0 | 140 | 192 | 0 | 1 | 148 | 0 | 0.4 | 1 | 0 | 1 | 1 |
| **6** | 56 | 0 | 1 | 140 | 294 | 0 | 0 | 153 | 0 | 1.3 | 1 | 0 | 2 | 1 |

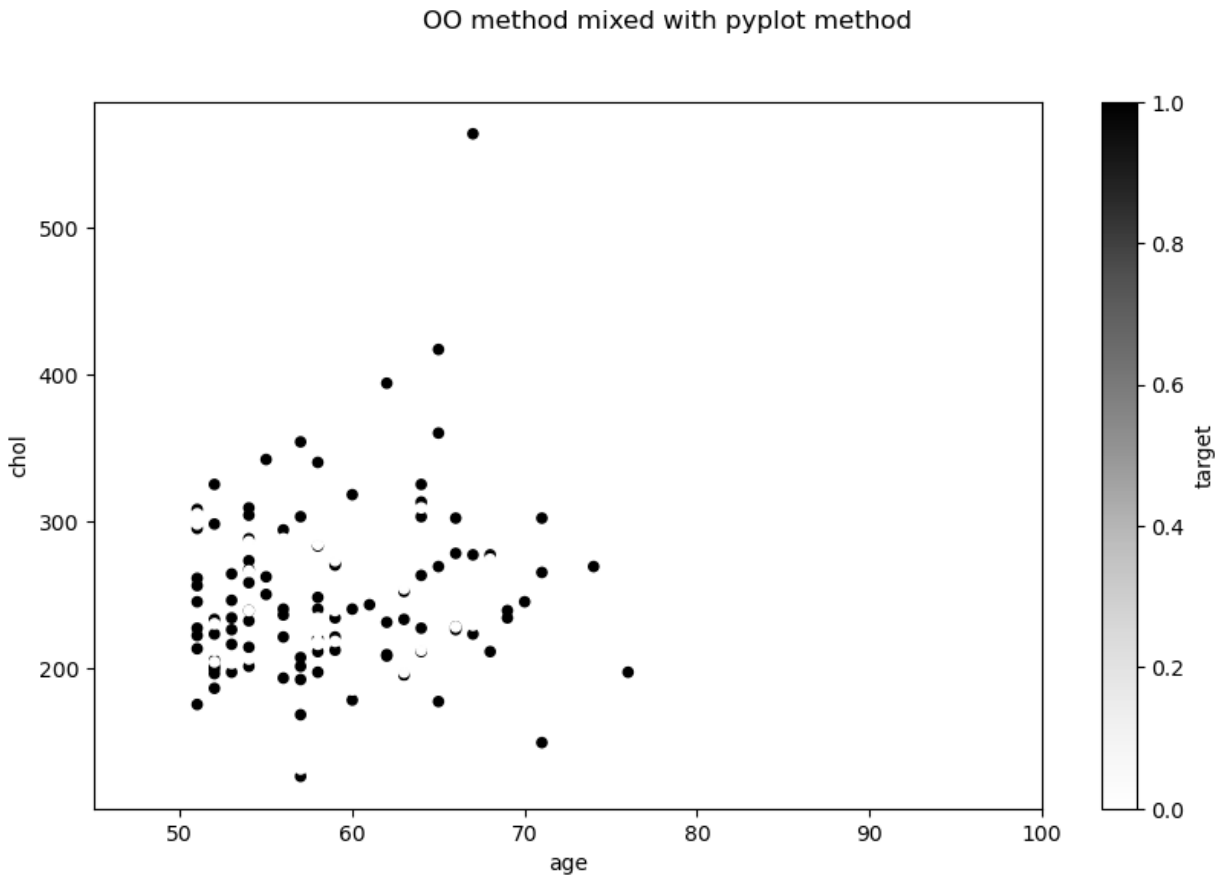
In [53]:
```
# pyplot method
over_50.plot(kind = 'scatter',
             x = 'age',
             y = 'chol',
             c = 'target');
```



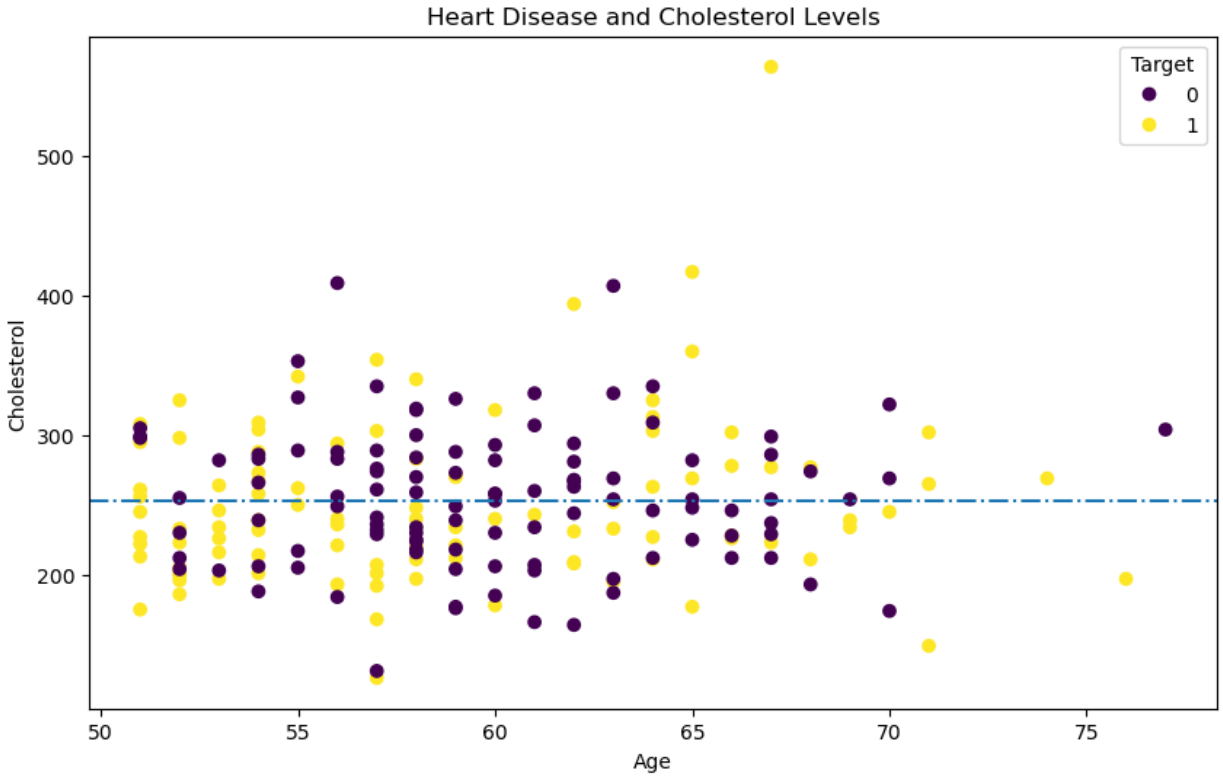
In [54]:
```
# OO method mixed with pyplot method
fig, ax = plt.subplots(figsize = (10, 6))
over_50.plot(kind = 'scatter',
             x = 'age',
             y = 'chol',
             c = 'target',
             ax = ax);
# ax.set_xlim([45, 100])
fig.suptitle('OO method');
```




In [55]:
```
fig, ax = plt.subplots(figsize = (10, 6))
over_50.plot(kind = 'scatter',
             x = 'age',
             y = 'chol',
             c = 'target',
             ax = ax);
ax.set_xlim([45, 100])
fig.suptitle('OO method mixed with pyplot method');
```




In [56]:
```
# OO method from scratch
fig, ax = plt.subplots(figsize = (10, 6))

# plot the data
scatter = ax.scatter(x = over_50['age'],
                     y = over_50['chol'],
                     c = over_50['target'] )

# customize
ax.set(title = 'Heart Disease and Cholesterol Levels',
       xlabel = 'Age',
       ylabel = 'Cholesterol')
# Add legend
ax.legend(*scatter.legend_elements(), title = 'Target')
# add horinzontal line
ax.axhline(over_50['chol'].mean(), linestyle = '-.');
```



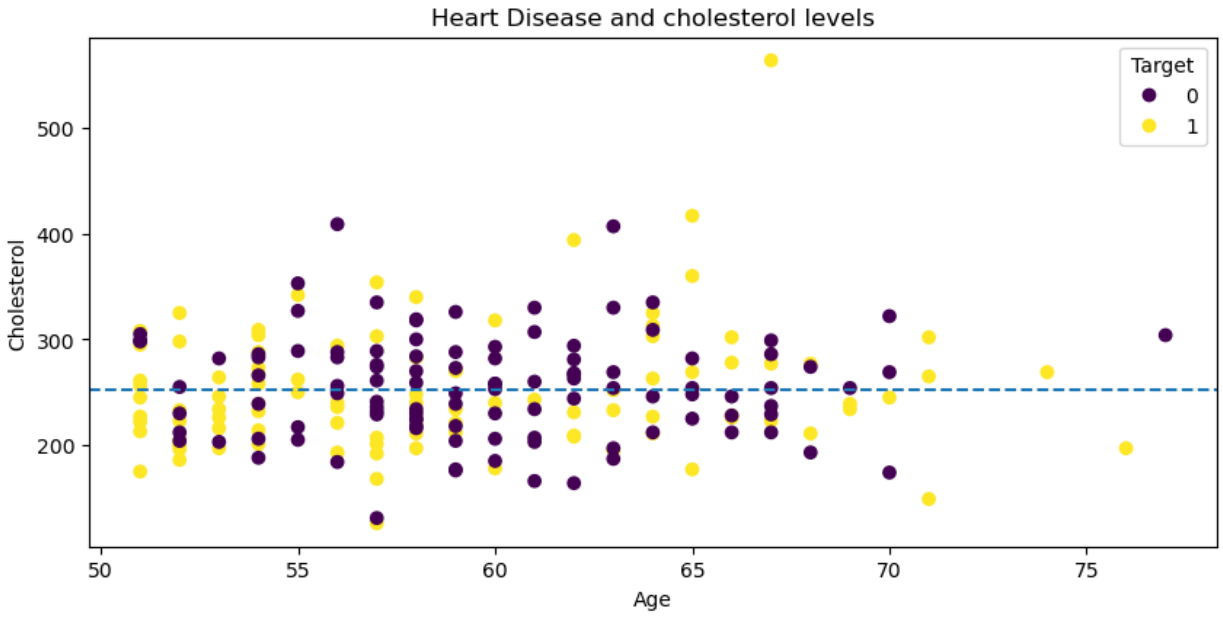

In [57]:
```
over_50.head()
```

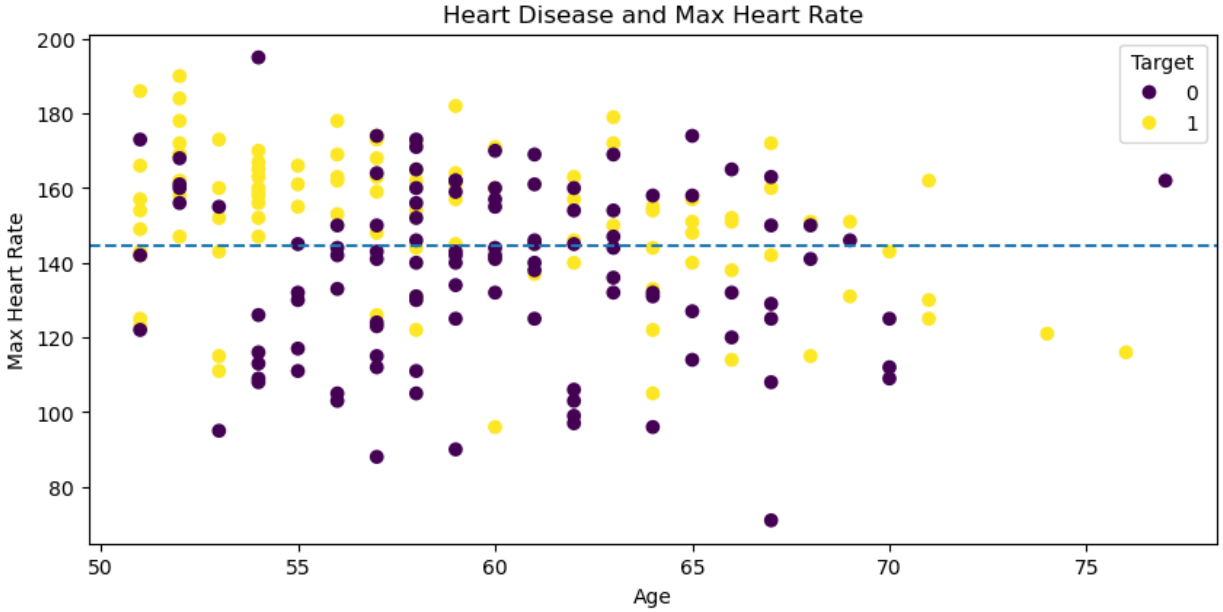
Out[57]:

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 63 | 1 | 3 | 145 | 233 | 1 | 0 | 150 | 0 | 2.3 | 0 | 0 | 1 | 1 |
| **3** | 56 | 1 | 1 | 120 | 236 | 0 | 1 | 178 | 0 | 0.8 | 2 | 0 | 2 | 1 |
| **4** | 57 | 0 | 0 | 120 | 354 | 0 | 1 | 163 | 1 | 0.6 | 2 | 0 | 2 | 1 |
| **5** | 57 | 1 | 0 | 140 | 192 | 0 | 1 | 148 | 0 | 0.4 | 1 | 0 | 1 | 1 |
| **6** | 56 | 0 | 1 | 140 | 294 | 0 | 0 | 153 | 0 | 1.3 | 1 | 0 | 2 | 1 |

In [58]:
```
# subplot of chol, age, thalach
fig, (ax0, ax1) = plt.subplots(nrows = 2,
                               ncols = 1,
                               figsize = (10, 10))

# add data to ax0
scatter = ax0.scatter(x = over_50['age'],
                      y = over_50['chol'],
                      c = over_50['target'])

# customize ax0
ax0.set(title = 'Heart Disease and cholesterol levels',
       xlabel = 'Age',
       ylabel = 'Cholesterol');

# add a legend to ax0
ax0.legend(*scatter.legend_elements(), title = 'Target')

# add a meanline
ax0.axhline(y = over_50['chol'].mean(),
           linestyle = '--');
```

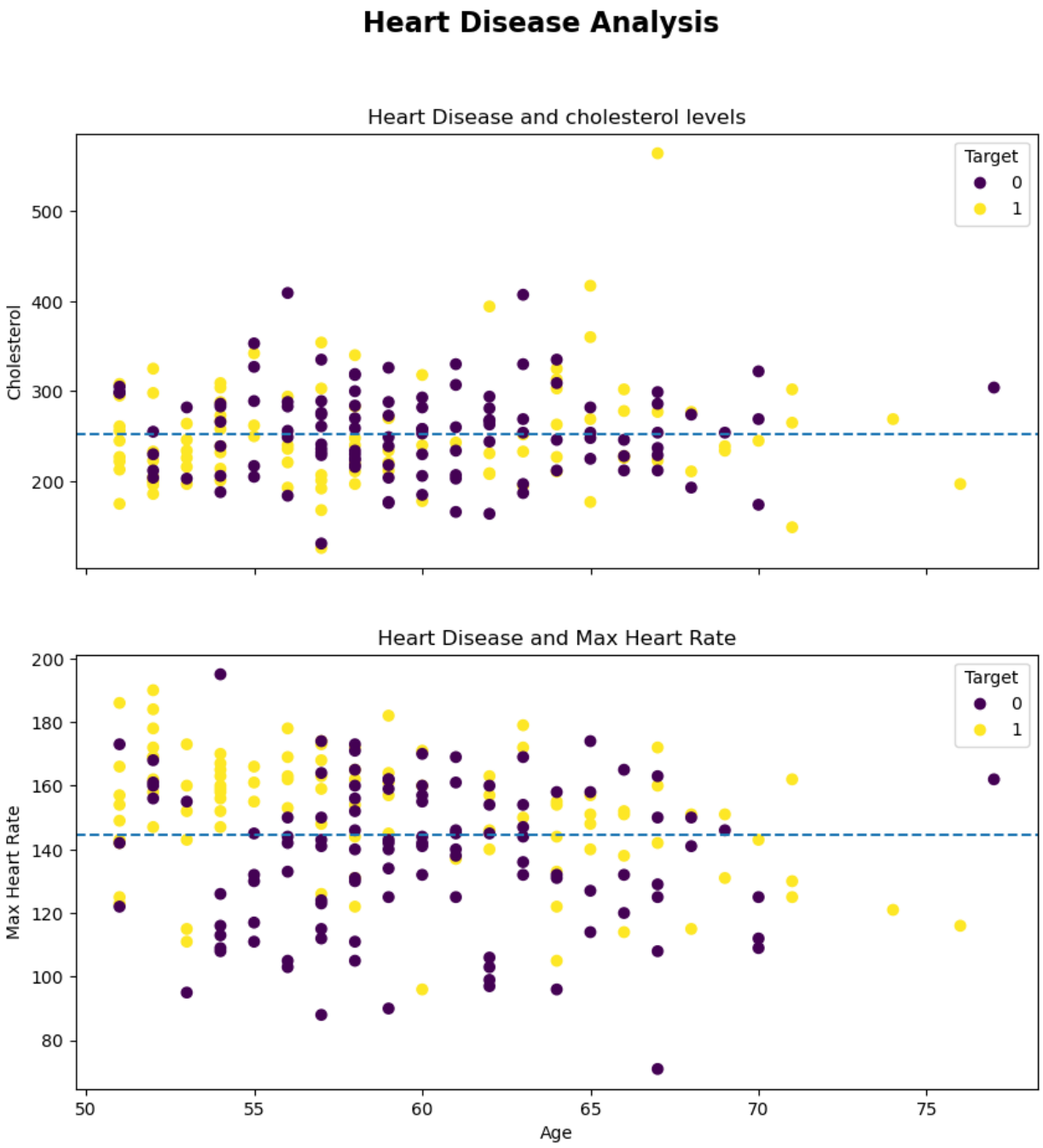
```
# add data to ax1
scatter = ax1.scatter(x = over_50['age'],
                      y = over_50['thalach'],
                      c = over_50['target'])
# customize ax1
ax1.set(title = 'Heart Disease and Max Heart Rate',
       xlabel = 'Age',
       ylabel = 'Max Heart Rate')

# add legend
ax1.legend(*scatter.legend_elements(), title = 'Target')

# add a meanline
ax1.axhline(y = over_50['thalach'].mean(),
           linestyle = '--');
```



# Here, since x above are same x = 'age', we can share x and add a title to the figures

In [59]:
```
# subplot of chol, age, thalach
fig, (ax0, ax1) = plt.subplots(nrows = 2,
                               ncols = 1,
                               figsize = (10, 10),
                               sharex = True)

# add data to ax0
scatter = ax0.scatter(x = over_50['age'],
                      y = over_50['chol'],
                      c = over_50['target'])

# customize ax0
ax0.set(title = 'Heart Disease and cholesterol levels',
       ylabel = 'Cholesterol');

# add a legend to ax0
ax0.legend(*scatter.legend_elements(), title = 'Target')

# add a meanline
ax0.axhline(y = over_50['chol'].mean(),
           linestyle = '--');

# add data to ax1
scatter = ax1.scatter(x = over_50['age'],
                      y = over_50['thalach'],
                      c = over_50['target'])
# customize ax1
ax1.set(title = 'Heart Disease and Max Heart Rate',
       xlabel = 'Age',
       ylabel = 'Max Heart Rate')

# add legend
ax1.legend(*scatter.legend_elements(), title = 'Target')

# add a meanline
ax1.axhline(y = over_50['thalach'].mean(),
           linestyle = '--');

# add a title to the figures
fig.suptitle('Heart Disease Analysis', fontsize = 16, fontweight ='bold');
```




# Customizing matplotlib plots and getting stylish

In [60]:
```
# see the different styles available
plt.style.available
```

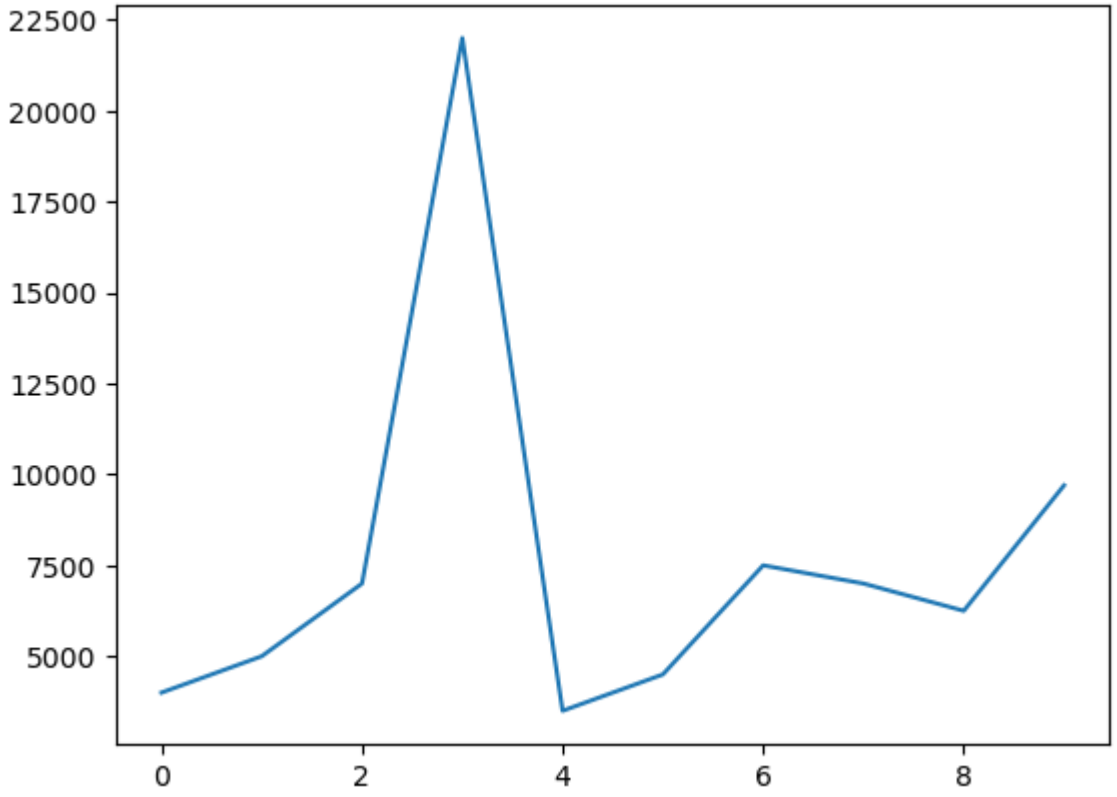
Out[60]:
```
['Solarize_Light2',
 '_classic_test_patch',
 '_mpl-gallery',
 '_mpl-gallery-nogrid',
 'bmh',
 'classic',
 'dark_background',
 'fast',
 'fivethirtyeight',
 'ggplot',
 'grayscale',
 'seaborn',
 'seaborn-bright',
 'seaborn-colorblind',
 'seaborn-dark',
 'seaborn-dark-palette',
 'seaborn-darkgrid',
 'seaborn-deep',
 'seaborn-muted',
 'seaborn-notebook',
 'seaborn-paper',
 'seaborn-pastel',
 'seaborn-poster',
 'seaborn-talk',
 'seaborn-ticks',
 'seaborn-white',
 'seaborn-whitegrid',
 'tableau-colorblind10']
```

In [61]:
```
car_sales.head()
```

Out[61]:

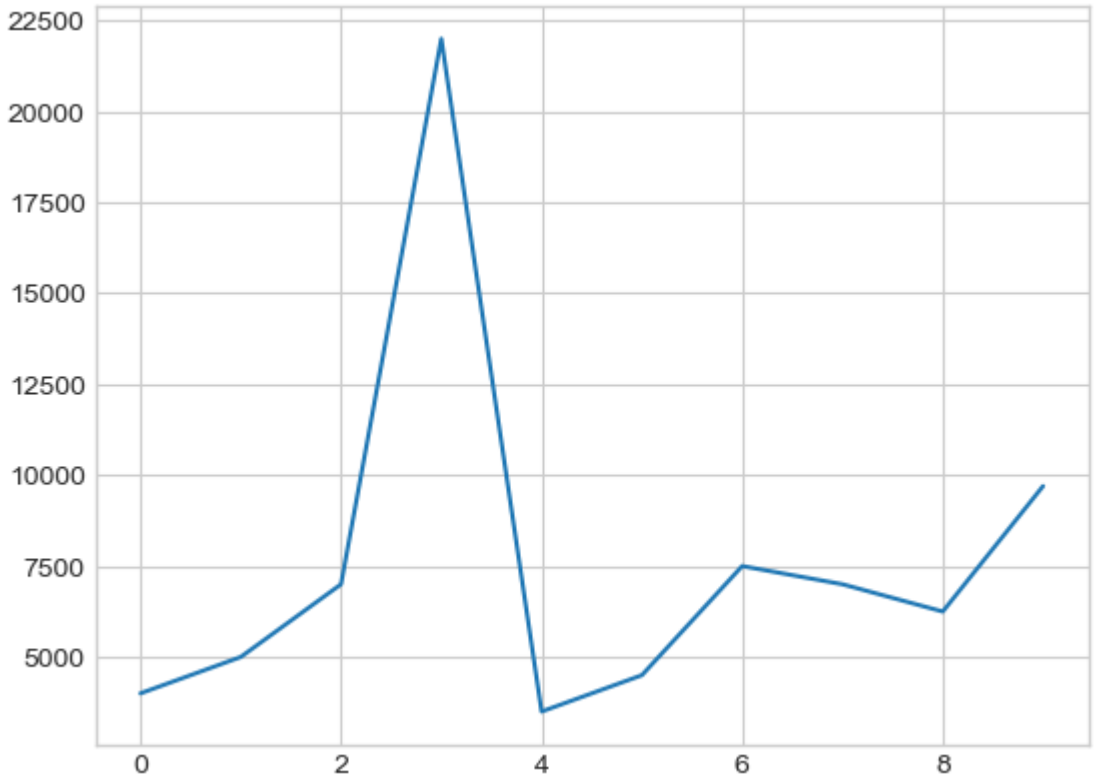
| | Make | Colour | Odometer (KM) | Doors | Price | Sale Date | Total Sales |
|---|---|---|---|---|---|---|---|
| **0** | Toyota | White | 150043 | 4 | 4000 | 2023-03-07 | 4000 |
| **1** | Honda | Red | 87899 | 4 | 5000 | 2023-03-08 | 9000 |
| **2** | Toyota | Blue | 32549 | 3 | 7000 | 2023-03-09 | 16000 |
| **3** | BMW | Black | 11179 | 5 | 22000 | 2023-03-10 | 38000 |
| **4** | Nissan | White | 213095 | 4 | 3500 | 2023-03-11 | 41500 |

In [62]:
```
# default style of plot
car_sales['Price'].plot();
```



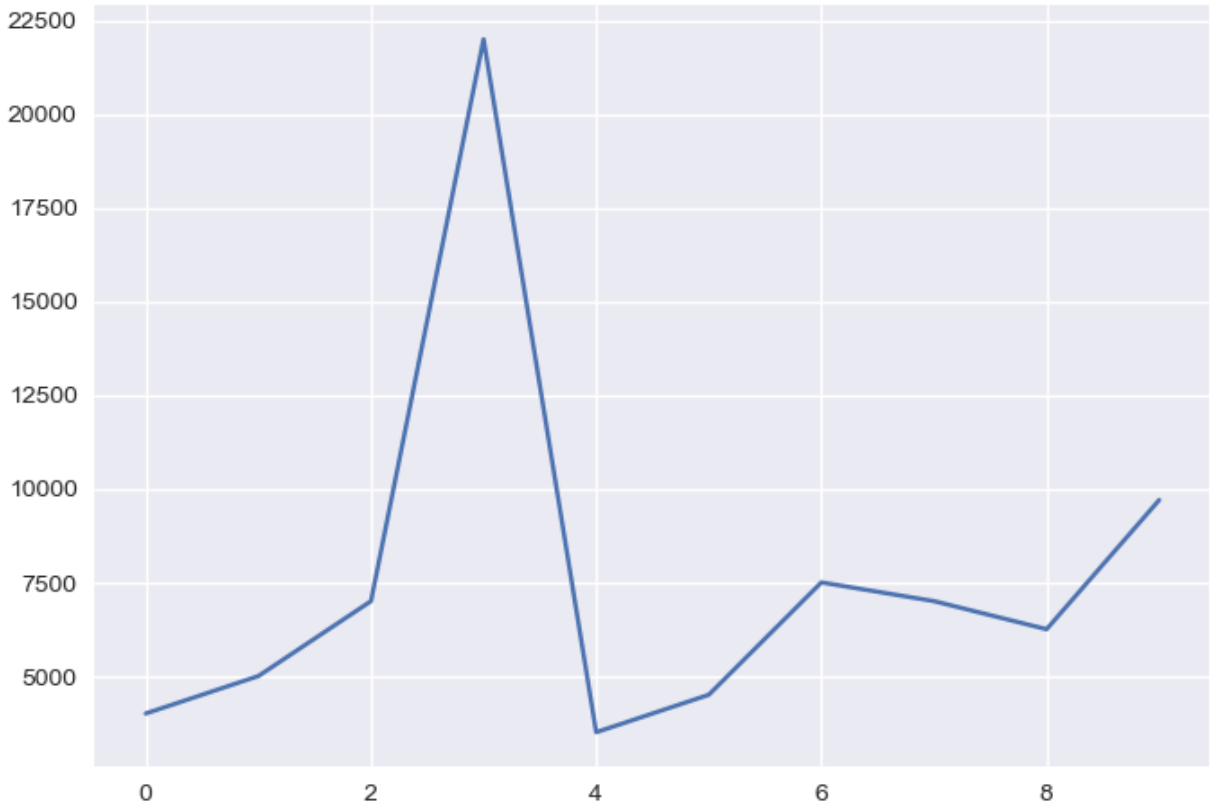

In [63]:
```
plt.style.use('seaborn-whitegrid')
```

In [64]:
```
car_sales['Price'].plot();
```

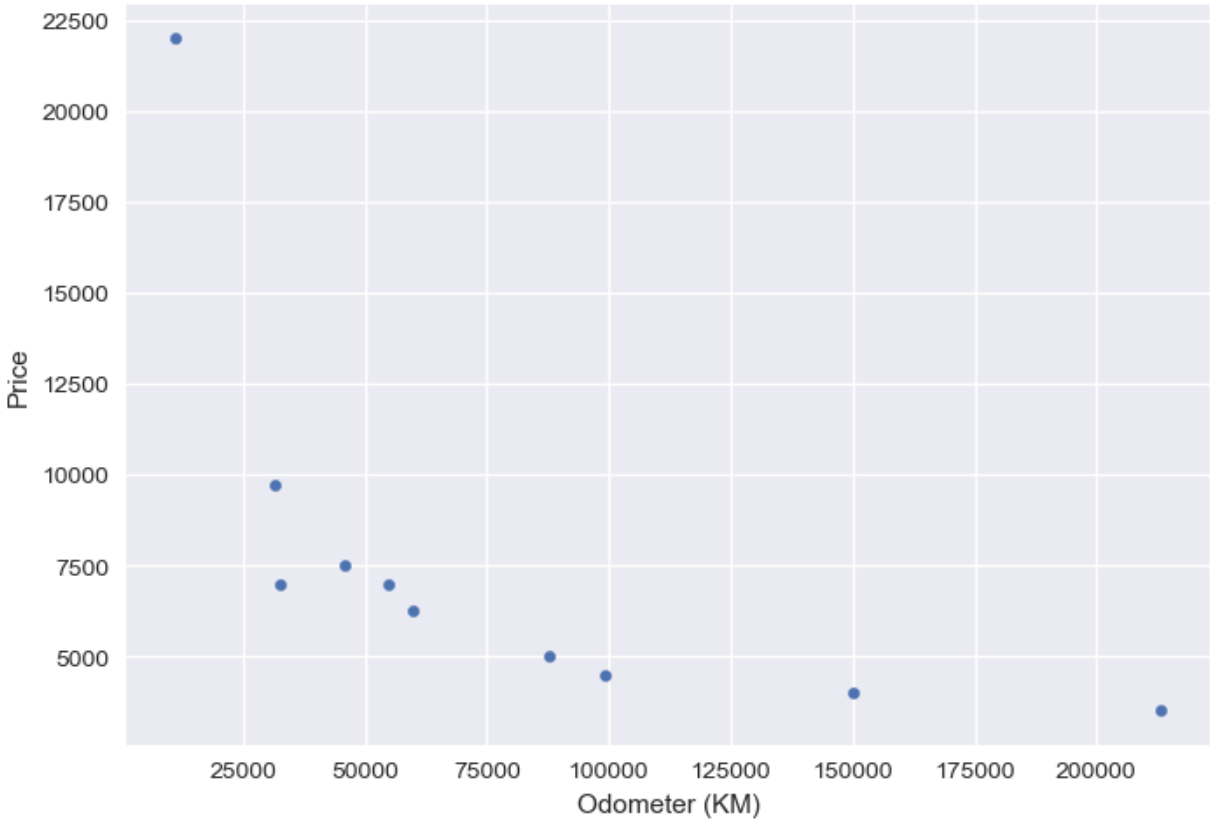



In [65]:
```
plt.style.use('seaborn')
```

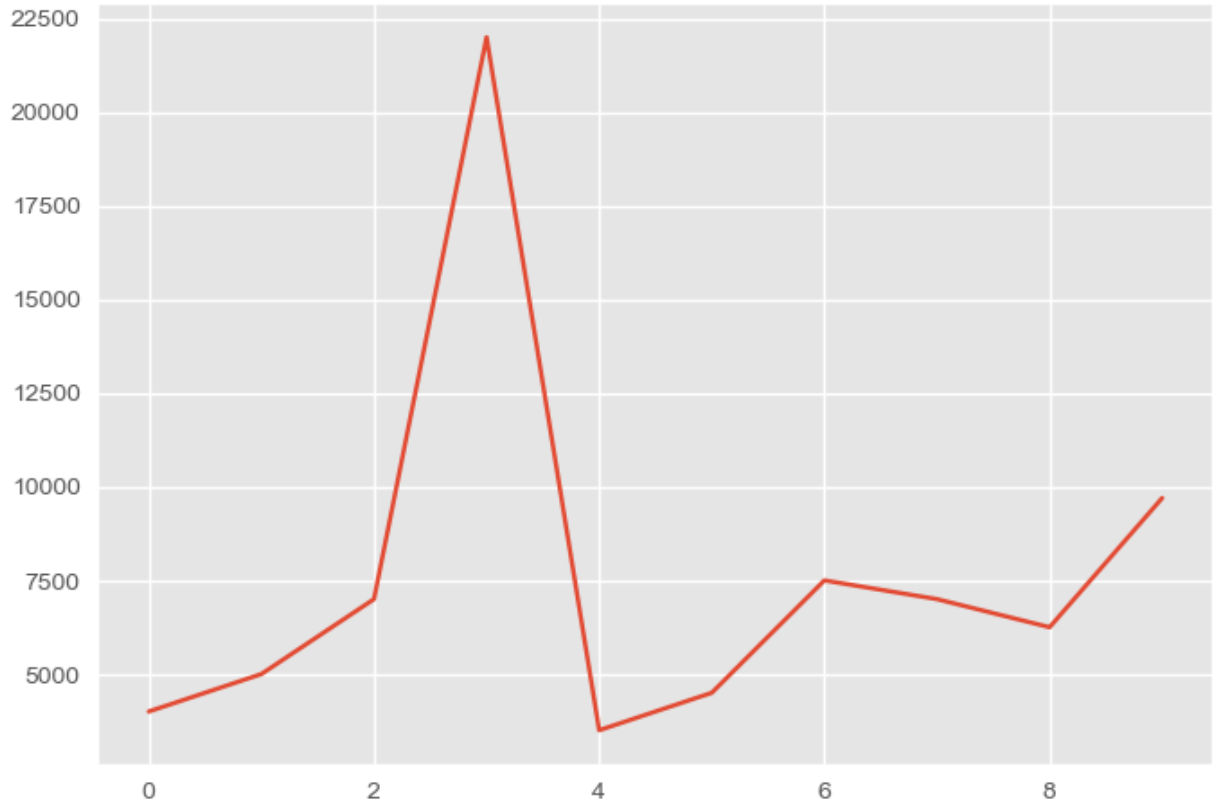
In [66]:
```
car_sales['Price'].plot();
```




In [67]:
```
car_sales.plot(x = 'Odometer (KM)', y = 'Price', kind = 'scatter');
```




In [68]:
```
plt.style.use('ggplot')
car_sales['Price'].plot();
```




In [69]:
```
# create some data
x = np.random.randn(10, 4)
x
```

Out[69]:
```
array([[-0.55436425, -0.79888677, -0.65840859,  0.73824136],
       [ 1.04891069,  0.36285482, -0.01512247,  0.12241351],
       [ 0.01900476, -0.61914026, -0.12469975,  0.10184485],
       [ 0.96987999,  0.36529189, -0.12236446,  1.49251068],
       [ 0.0722019 ,  0.64127839, -0.79478693,  0.37423713],
       [ 0.63838117, -0.42240829,  0.09962913,  1.01078803],
       [-0.0646441 ,  1.49337941,  0.56607175,  0.14062773],
       [ 0.29883631,  0.33892667, -1.06665882, -0.17837147],
       [ 1.56723593, -0.92488692, -1.23307885,  1.43547764],
       [-0.24296492, -1.89674674, -1.07357028,  1.78866227]])
```

In [70]:
```
df = pd.DataFrame(x, columns = ['a', 'b', 'c', 'd'])
df
```

Out[70]:

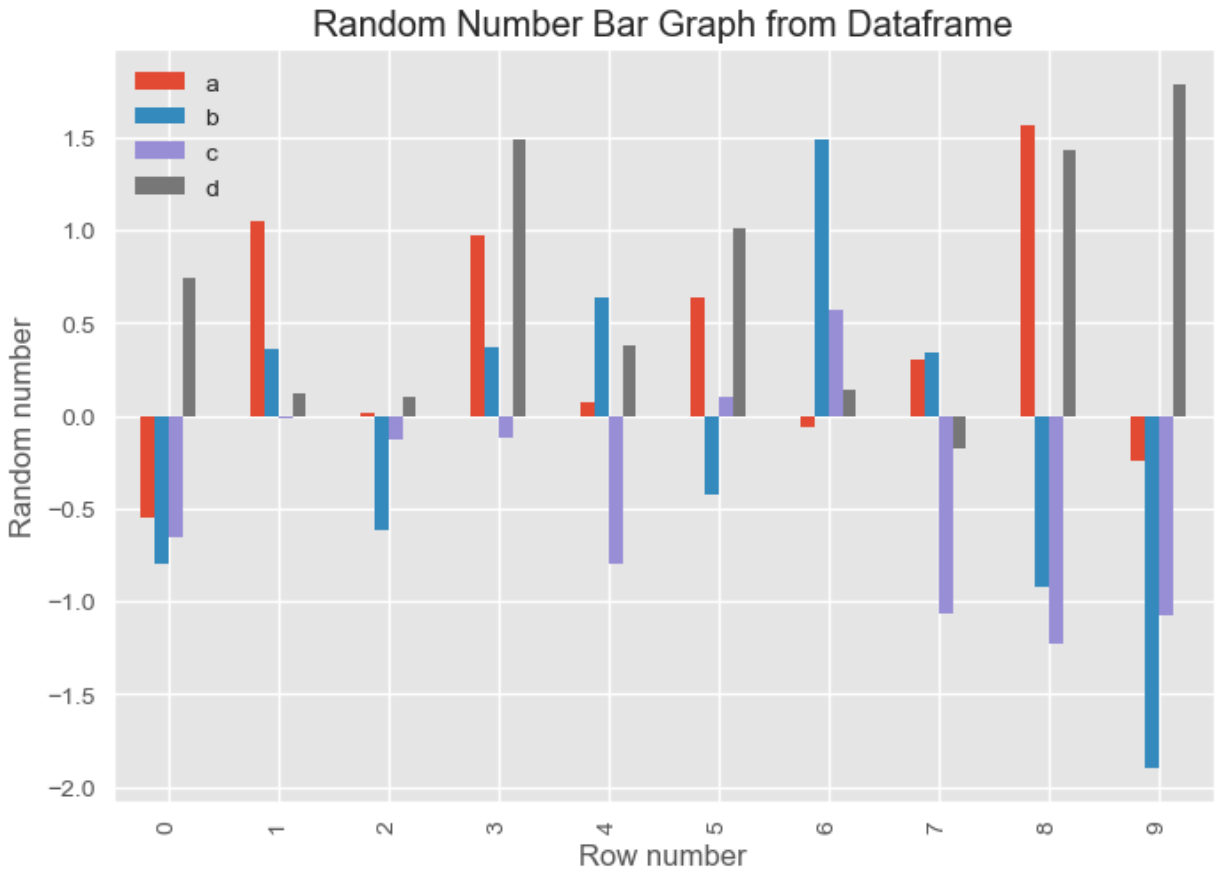
| | a | b | c | d |
|---|---|---|---|---|
| **0** | -0.554364 | -0.798887 | -0.658409 | 0.738241 |
| **1** | 1.048911 | 0.362855 | -0.015122 | 0.122414 |
| **2** | 0.019005 | -0.619140 | -0.124700 | 0.101845 |
| **3** | 0.969880 | 0.365292 | -0.122364 | 1.492511 |
| **4** | 0.072202 | 0.641278 | -0.794787 | 0.374237 |
| **5** | 0.638381 | -0.422408 | 0.099629 | 1.010788 |
| **6** | -0.064644 | 1.493379 | 0.566072 | 0.140628 |
| **7** | 0.298836 | 0.338927 | -1.066659 | -0.178371 |
| **8** | 1.567236 | -0.924887 | -1.233079 | 1.435478 |
| **9** | -0.242965 | -1.896747 | -1.073570 | 1.788662 |

In [71]:
```
ax = df.plot(kind = 'bar')
type(ax)
```

Out[71]:
```
matplotlib.axes._subplots.AxesSubplot
```


In [72]:
```
# customize our plot with the set() method
ax = df.plot(kind = 'bar')

# add some labels and a title
ax.set(title = 'Random Number Bar Graph from Dataframe',
     xlabel = 'Row number',
      ylabel = 'Random number')
```

```
# make the legend visible
ax.legend().set_visible(True)
```

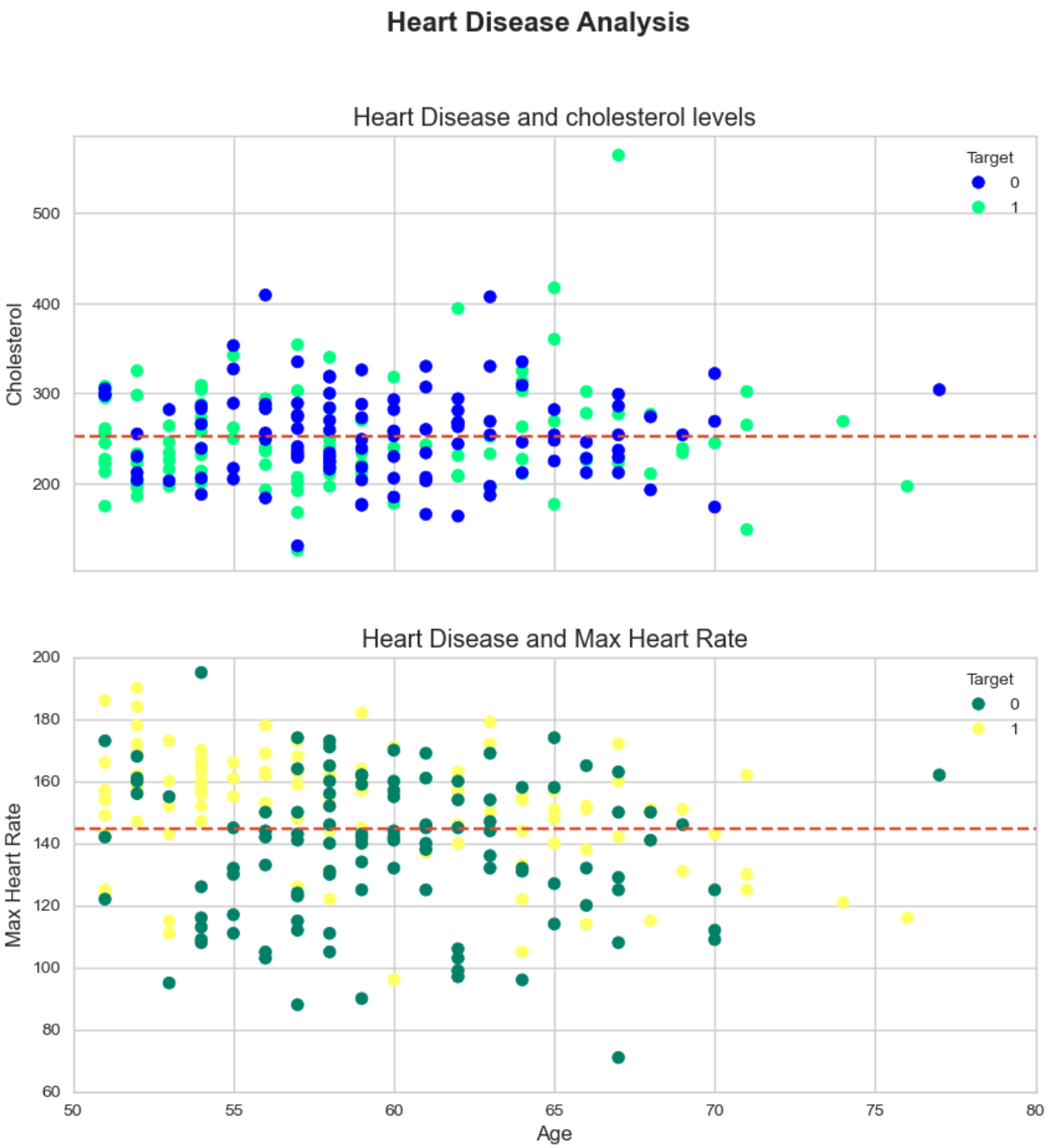



In [76]:
```
# set the style
plt.style.use('seaborn-whitegrid')

# OO method from scratch
fig, ax = plt.subplots(figsize = (10, 6))

# plot the data
scatter = ax.scatter(x = over_50['age'],
                     y = over_50['chol'],
                     c = over_50['target'],
                     cmap = 'summer') # this chnages the colour scheme

# customize
ax.set(title = 'Heart Disease and Cholesterol Levels',
       xlabel = 'Age',
       ylabel = 'Cholesterol')
# Add legend
ax.legend(*scatter.legend_elements(), title = 'Target')
# add horinzontal line
ax.axhline(over_50['chol'].mean(), linestyle = '-.');
```


This plot shows infromation about the heart disease dataset...

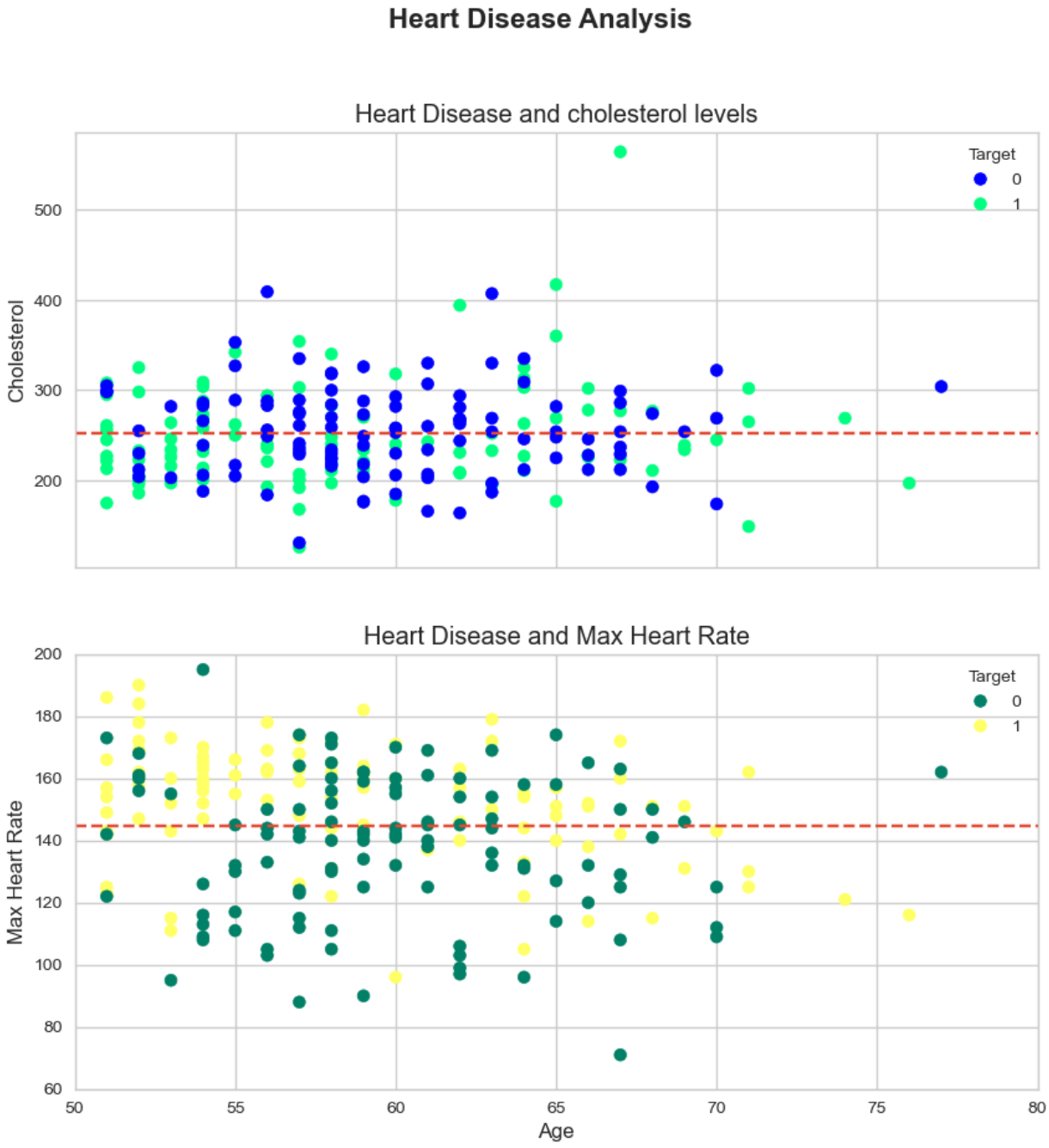
In [83]:
```
# customizing the y and x axis limitations

# subplot of chol, age, thalach
fig, (ax0, ax1) = plt.subplots(nrows = 2,
                               ncols = 1,
                               figsize = (10, 10),
                               sharex = True)

# add data to ax0
scatter = ax0.scatter(x = over_50['age'],
                      y = over_50['chol'],
                      c = over_50['target'],
                      cmap = 'winter')

# customize ax0
ax0.set(title = 'Heart Disease and cholesterol levels',
       ylabel = 'Cholesterol');
# change the x axis limits
ax0.set_xlim([50, 80])

# add a legend to ax0
ax0.legend(*scatter.legend_elements(), title = 'Target')

# add a meanline
ax0.axhline(y = over_50['chol'].mean(),
           linestyle = '--');

# add data to ax1
scatter = ax1.scatter(x = over_50['age'],
                      y = over_50['thalach'],
                      c = over_50['target'],
                      cmap = 'summer')
```

```
# customize ax1
ax1.set(title = 'Heart Disease and Max Heart Rate',
       xlabel = 'Age',
       ylabel = 'Max Heart Rate')
# change ax1 x axis limits
ax1.set_xlim([50, 80])
ax1.set_ylim([60, 200])
# add legend
ax1.legend(*scatter.legend_elements(), title = 'Target')

# add a meanline
ax1.axhline(y = over_50['thalach'].mean(),
           linestyle = '--');

# add a title to the figures
fig.suptitle('Heart Disease Analysis', fontsize = 16, fontweight ='bold');
```



In [84]:
```
fig
```

Out[84]:




In [85]:
```
fig.savefig('heart-disease-analysis-plot-saved-with-code.png')
```

In [ ]:
```

```